` "A RANDOMISED CONTROLLED STUDY COMPARING THE ANALGESIC EFFICACY OF THORACIC EPIDURAL ANALGESIA VERSUS ULTRASOUND GUIDED RECTUS SHEATH BLOCK FOR MIDLINE LAPAROTOMY SURGERY"

Dissertation submitted to

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in partial fulfilment for the award of the degree of

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IN

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BRANCH X

DEPARTMENT OF ANAESTHESIOLOGY

& CRITICAL CARE

STANLEY MEDICAL COLLEGE

CHENNAI-600 001

APRIL 2016

DECLARATION BY THE CANDIDATE

I hereby declare that the dissertation entitled "**RANDOMISED CONTROLLED STUDY COMPARING THE ANALGESIC EFFICACY OF THORACIC EPIDURAL ANALGESIA VERSUS ULTRASOUND GUIDED RECTUS SHEATH BLOCK FOR MIDLINE LAPAROTOMY SURGERY**" has been prepared by me under the Guidance of **Prof. Dr. S. PONNAMBALA NAMASIVAYAM**, Professor of Anaesthesiology, Department of Anaesthesiology, Stanley Medical College, Chennai, in partial fulfilment of the regulations for the award of the degree of **M.D (ANAESTHESIOLOGY)**, examination to be held in April 2016.

This study was conducted at Department Of Anaesthesiology, Stanley Medical College, Chennai.

I have not submitted this dissertation previously to any university for the award of any degree or diploma.

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INTRODUCTION

Midline laparotomy surgery is done commonly in our institution. Pain associated with laparotomy causes undue distress and is injurious to the patient. In addition to the pain being physically and emotionally incapacitating, it is accompanied with several physiological effects which augment the perioperative stress response.

The postoperative pain prevents early ambulation of the patient, thus making them prone to deep vein thrombosis, pulmonary atelectasis, muscle wasting and urinary retention that ultimately contributes to increased morbidity, increased length of hospital stay and at times even mortality. Adequate postoperative analgesia is essential to prevent complications such as systemic hypertension, myocardial ischemia or infarction, cardiac arrhythmias, respiratory compromise, pneumonia, postoperative ileus and delayed wound healing.[1] Moreover, the severity of acute pain may lead on to distressing postsurgical chronic pain.[2] Pain after laparotomy is more pronounced in the first 48 hours postoperatively and is aggravated during mobilisation or coughing, than during rest.

Epidural analgesia is a recognised technique which is considered as the gold standard in the management of postoperative pain. Epidural analgesia is commonly used in perioperative and postoperative period. It has been demonstrated to improve postoperative outcome and attenuate the

physiological stress response in the postsurgical period. But the technique of epidural analgesia is not without complications which may include postdural puncture headache, total spinal anaesthesia, seizures due to unintentional vascular injections, epidural hematoma and epidural abscess. Moreover, physiological side effects such as hypotension, motor blockade, and urinary retention are not uncommon.[3]

The use of multimodal analgesia techniques to facilitate the patient with adequate analgesia for laparotomy surgeries involving midline incisions extending anywhere between xiphisternum and pubic symphysis had been used, to reduce the perioperative use of opioids and its ill effects. With the advent of Ultrasound guidance, the anaesthesiologists now are reconsidering old techniques for extensive clinical use. The rectus sheath block (RSB) is an old but useful technique, under-utilized in the adult population.

The rectus sheath block is an old regional anaesthetic technique but with the advent of long acting local anaesthetic agents and compact portable ultrasound equipment, it has re-emerged as a novel analgesic technique for the management of postoperative pain.[4] The technique aims to block the ventral rami of T_7-T_{12} intercostal nerves that innervate the rectus abdominis muscles and overlying skin.[5] It is a compartmental block done by injecting local anaesthetic into the potential space between the rectus muscle and the posterior rectus sheath. By introducing a catheter in situ within this space, the

block can be topped up using intermittent bolus at regular intervals or continuous infusion of local anaesthetics.

Taking all these into consideration we decided to conduct a prospective randomized controlled study at Govt. Stanley Medical college hospital, comparing the analgesic efficacy of USG guided rectus sheath block (RSB) with thoracic epidural analgesia (TEA) for postoperative pain relief in patients undergoing midline laparotomy surgery under general anaesthesia.

AIM OF THE STUDY

To compare the analgesic efficacy of USG guided Rectus Sheath Block with Thoracic Epidural Analgesia for postoperative pain management following midline laparotomy surgery.

OUTCOMES MEASURED

Primary Outcome measures:

Assessment of the postoperative pain by Visual Analogue pain score (VAS).

Secondary Outcome measures:

a. Postoperative Nausea and vomiting (PONV)

b. Rescue Analgesic requirement

c. Patient Satisfaction

d. Therapeutic/Technical failure rate.

ANATOMY OF EPIDURAL SPACE

Vertebral column is made of 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 coccygeal vertebrae. The spinal canal is formed by the adjacent vertebral formina. The spinal canal offers support and protection to the spinal cord and its nerve roots.[6]

The spinal cord and its root are surrounded by three layers of membrane, inner most is the piamater. The second layer is the arachnoid mater and the space between the piamater and arachnoid mater is the subarachnoid space filled with cerebrospinal fluid. The outermost layer is the duramater and the space between the arachnoid and the duramater is the subdural space and finally the space out side the dura mater is the extradural (or) epidural space.

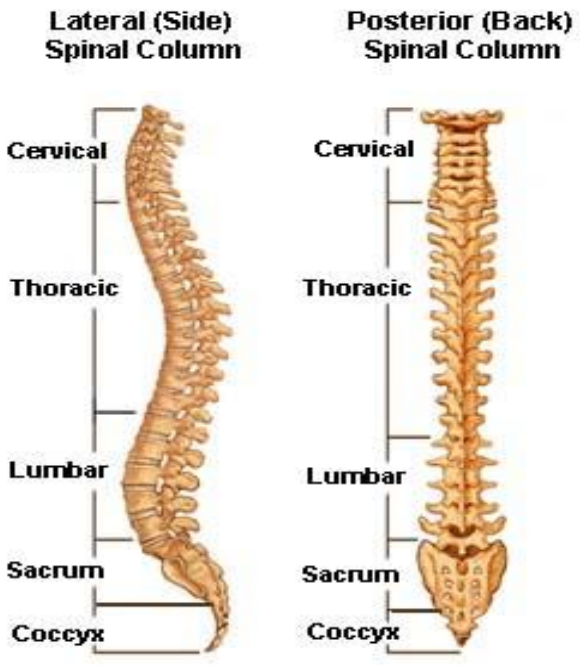

Figure 1: Anatomy of vertebral column

To enter the epidural space the needle has to pass through skin, subcutaneous tissue, supra spinous ligament, inter spinous ligament and ligamentum flavum.

EPIDURAL SPACE

It is a potential space which extends from the foramen magnum to the sacral hiatus and surrounds the duramater anteriorly, laterally and posteriorly (Fig.2).

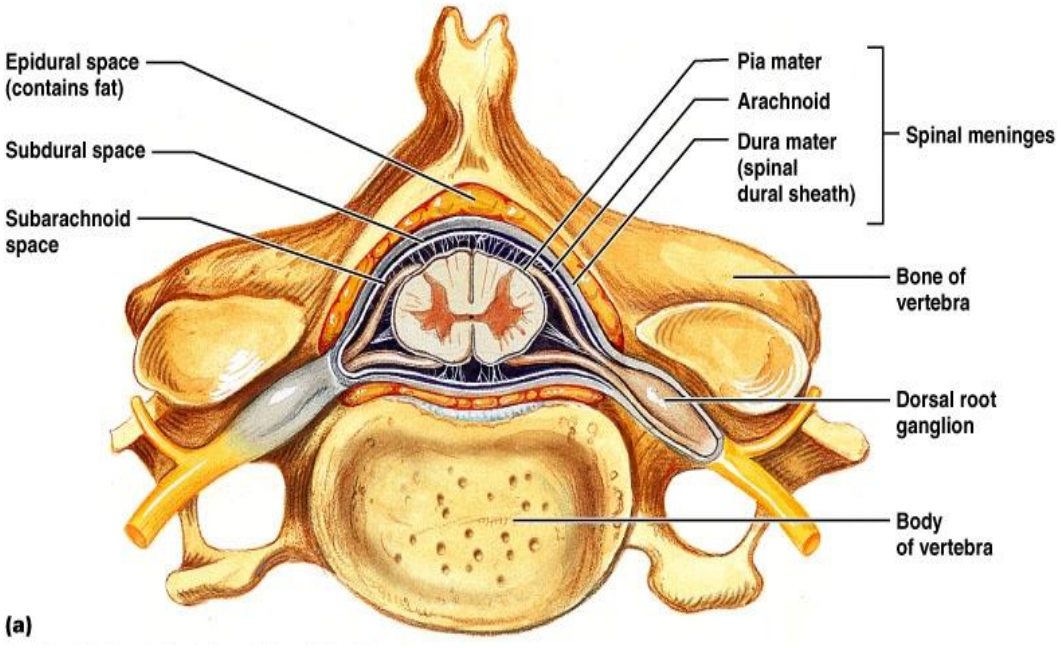

Figure 2: Anatomy of epidural space

It has the following boundaries

- **above**: foramen magnum
- **below**: sacrococcygeal ligament
- **anterior**: posterior longitudinal ligament
- **posterior**: lamina, ligamentum flavum
- **lateral**: pedicle, intervertebral foramina

CONTENTS OF THE EPIDURAL SPACE:

Fat, areolar tissue, lymphatics, veins and nerve roots are present in the epidural space, without any free fluid. The volume is more in obese people and less in elderly people, due to reduction in the epidural fat there by leading to reduction in dose requirements.

Also in obese patients and pregnant females there is an increased chance of catheter migration due to compression of Inferior vena cava and also due to continuation of Bateson's plexus of veins with iliac veins in the pelvis and azygos veins of thorax and abdomen. Usually, the distance of the epidural space from the skin is about 4.5-5cm in 75-80% of individuals and also varies at different vertebral levels.

EPIDURAL ANALGESIA

INDICATIONS

1) As an adjuvant to general anesthesia, and also to reduce the opioids and other analgesic requirements in the intra operative period, eg.

- Gynaecologial surgeries
- Abdominal surgeries
- Thoracic surgeries
- Orthopaedic surgeries
- Vascular sugeries

2) For analgesia alone such as in Labour analgesia, where it will not produce motor blockade, and analgesia is not sufficient for performing surgery.

3) As a sole technique for surgical anesthesia eg. Lower segment caesarian sections, urological surgeries, lower limb surgeries and lower abdominal surgeries.

4) Management of chronic pain in terminally ill patients and treatment of back pain eg. Epidural steroid.

5) Postoperative analgesia after a surgery, with the help of catheter in the epidural space as continuous infusion or intermittent boluses.

CONTRAINDICATIONS

The absolute contra indications are

- patient refusal
- raised intracranial tension
- infection at the site of injection
- severe hypovolemia & shock
- Coagulopathy
- Severe stenotic valvular heart disease

The relative contraindications are

- spine deformity
- neurological disorders—demyelinating disease
- sepsis
- unco-operative patient
- Ventricular outflow tract obstruction

COMPLICATIONS

- Local anaesthetic toxicity and allergy
- Hypotension
- Inadvertent high blockade

- Epidural abscess, hematoma, meningitis
- Post dural puncture headache
- Anterior spinal artery syndrome
- Arachnoiditis
- Transverse myelitis
- Catheter migration into the epidural vessels.[7]

POSTOPERATIVE PAIN

Postoperative pain has deleterious effect in almost all systems of the body [8]

1) In the cardio vascular system the pain causes increase is heart rate , blood pressure, increase is systemic vascular resistance and cardiac work. This may precipitate angina and myocardial infarction in susceptible individuals.

2) In the respiratory system, hypoxia, hypercarbia, atelectasis, decreased vital capacity and cough to clear the secretions resulting in ventilation perfusion mismatch and other complications.

3) In the gastro intestinal system, vomiting and ileus may occur.

4) In the renal system, urinary retention and decreased urine output may occur.

5) There may be an increased risk of thromboembolism due to pain and limited mobility.

6) In the endocrine system, there will be symphathetic stimulation, hyper metabolism and increased oxygen comsumption.

7) And finally, in the central nervous system anxiety, fear and fatigue ensues.

ADVANTAGES OF POST OPERATIVE EPIDURAL ANALGESIA

- The reduction in vital capacity in upper abdominal surgeries are around 75% where as in lower abdominal surgeries it is around 50 –55%. So thoracic epidural analgesia provides effective pain relief thereby improving vital capacity and other pulmonary functions .

- In the cardio vascular system it reduces blood loss and transfusion requirements, reduces the incidence of angina, myocardial infarction and deep vein thrombosis.

- In the endocrine system there is reduction in the level of catcholamines and overall reduction in morbidity, mortality and duration of hospital stay.

PHYSIOLOGICAL EFFECTS OF EPIDURAL BLOCKADE

The local anesthetic when injected into the epidural space acts on the spinal nerve roots.[9] The segmental nerve roots in the thoracic and lumbar regions are mixed nerves which comprises somatic sensory, motor and autonomic nerve fibres. Sensory blockade leads to interruption in the transmission of both somatic and visceral painful stimuli where as motor blockade offers muscle relaxation and there is varying degrees of sympathetic blockade.

The injection site in epidural anaesthesia should be as close to the target nerve roots as possible to obtain better results.The important concept for epidural anaesthesia is a differential nerve block. It means the nerve fibres with variable function exhibit a varying sensitivity to the effects of local anesthetics.

The order of blockade in epidural anaesthesia are sympathetic blockade, then pain, temperature, proprioception and subsequently motor blockade . Usually following an epidural block, the sympathetic blockade particularly temperature vary from 1-4 segments higher than the motor blockade, where as regression of level occurs in reverse order.

Effects on Cardiovascular System

The effect on the cardiovascular system is determined by the level of blockade. Vasomotor tone is maintained by T5 – L1 sympathetic fibers which innervate vascular smooth muscles. When these fibres are blocked, arterial and veno dilatation with pooling of blood and decreased systemic vascular resistance occurs.

Effects in the respiratory system:

It has minimal effect in patients with adequate pulmonary function. Tidal volume, vital capacity , minute ventilation and dead space are unchanged.There is no alteration in pulmonary function, even with high thoracic blockade. Even in intercostal paralysis by a high thoracic block major alteration is hardly noticed.

Effects in the gastro intestinal system:

Due to blockade of sympathetic fibres from T5 – L1 there is an unopposed vagal action leading to increase in peristalsis and a smaller contracted intestines.

Effects on renal system:

Epidural anesthesia has little effect on renal function due to auto regulation of renal blood flow, though urinary retention is common.

Mechanism of Action of local anaesthetics in the epidural space:

In the epidural space local anesthetics bind to sodium channels, in the inactivated state preventing further activation of the channel and development of action potential. They block the sodium and potassium ion channels in the dorsal horn and inhibit the generation and transmission of pain signals and produce similar action in the ventral horn as well. In the spinal cord, calcium channels are blocked producing resistance to stimuli from nociceptive afferent neurons and there by producing analgesia. Also the local anaesthetics inhibit the release of substance P and other neuro transmitters like glutamate, calcitonin gene related peptide (CGRP) neurokinin (I& II) in the epidural space and therefore inhibit pain signal transmission.

Factors affecting the action of local anaesthetics in the epidural space:

Site of injection:There is equal spread of local anaesthetics in the thoracic epidural space and cranial (or) cephalad spread in lumbar epidural space.

Volume: 1.5 – 2ml per segment for lumbar segment and 1- 1.5ml per segment for thoracic segments.

Age: In old age the inter spinous spaces become narrowed due to calcification of ligaments lead to reduced dose requirements.

Weight: Obese individuals and pregnant females require less volume because of space narrowing and venous engorgement in the epidural space.

Height:Shorter individuals require lesser volume.

Alkalinisation of local anesthetics :Alkalinisation potentiates the onset of action.

Posture has little effect.

Adjuvants : Addition of adjuvants enhance the quality of blockade, eg.

opioids, alpha2 agonist, ketamine etc.

COMMON TECHNIQUES OF EPIDURAL BLOCK

Usually in sitting or lateral decubitus position, through midline (or) paramedian approach.[10]

Various needles used are[11]

1. Crawford point needle
2. Tuohy Huber point needle – It has a blunt leading edge and a lateral opening at the tip. This needle is a standard directional needle used for epidural anaesthesia.
3. Hustead Needle – It is a modified Tuohy needle with a rounded tip and a bevel opening which is located 2.7 mm from the tip in the 18G needle. The advantage of this needle is the lower incidence of catheter shearing.

Figure 3: Tuohy needle

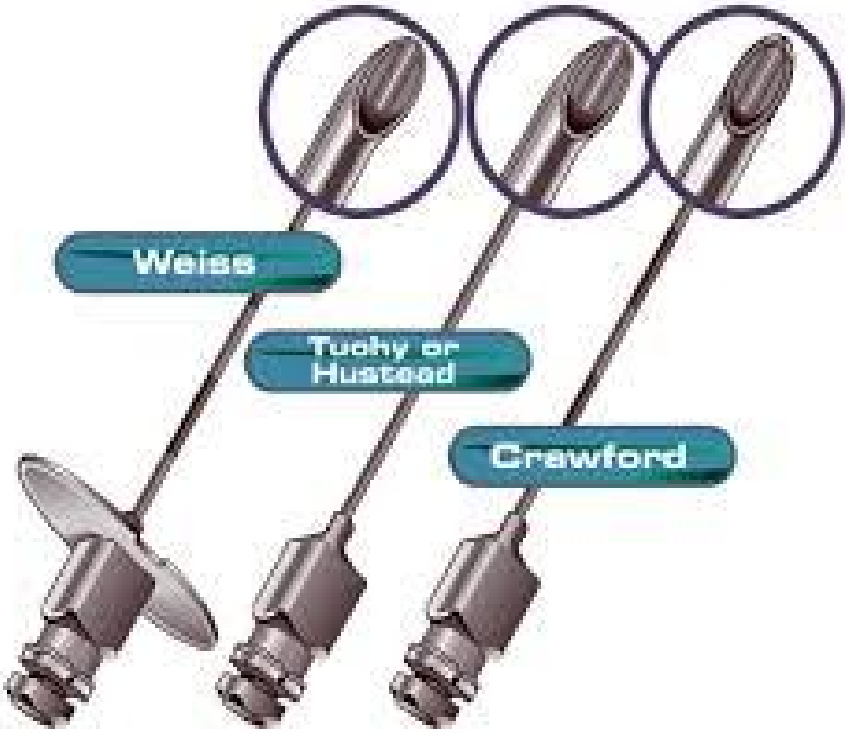

Figure 4: Various types of epidural needle

Various methods of identifying epidural space:

• Loss of resistance technique.It is the most commonly used method. LOR with air (or) saline and the test is called as whoosh test, but there is risk of air embolism in Children.[12,13]

• Hanging drop method [14]

• Recently a pressure transducer used saline filled sterile tubing is connected to the epidural needle,and if the needle tip enters into the space, the pressure will drop suddenly. This is useful in obese patients and identifying epidural space in the cervical region.This is called as epidural space identifier.

• Modified drip method (1991)

• Macintosh epidural balloon (2008)

• Epidrum (it is an optimal pressure loss of resistance device) (2011)

• Neuraxial ultrasonography recently developed for identification of epidural space (2010).

• Epiduroscopy.

TECHNIQUE

Loss of resistance (LOR) is the most common technique used to identify the epidural space. A 5ml syringe containing air or saline is attached

to the Tuohy needle. The needle is advanced with the left thumb and index finger with the back of the hand held against the back of the patient. Pressure is now applied on the plunger with the thumb of the right hand and maintained as the needle is further advanced.

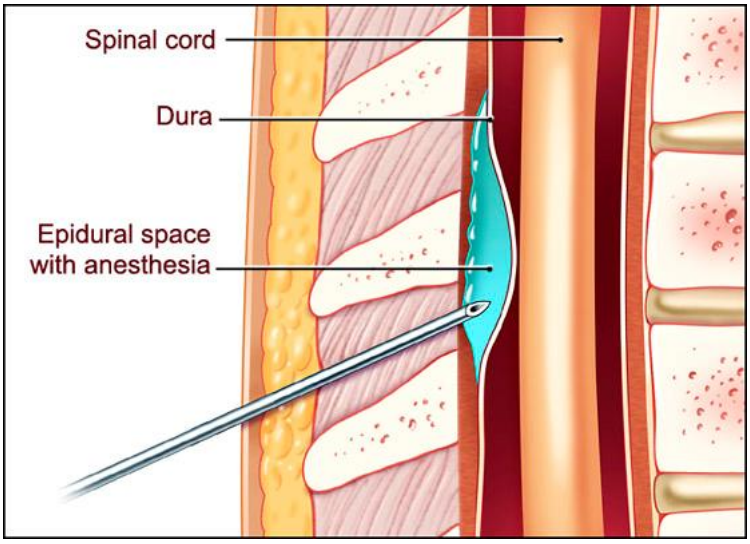

Figure 5: Epidural space

Having passed through skin, subcutaneous tissue, supra spinous ligament, inter spinous, as soon as the ligamentum flavum is pierced, resistance to syringe plunger is lost and the epidural space is entered. This secure grip of the epidural needle to maintain its position in the epidural space is called the “Bromage grip”.

TEST DOSE[15]

- Ideal test dose contains 5mcg of 1:200,000 adrenaline each ml of LA.
- It identifies both intravascular and intrathecal placement

- Effective doses of local anaesthetic solution
    - lignocaine - 45mg
    - bupivacaine - 15mg
    - ropivacaine - 16mg
- Criteria for positive epinephrine test (ASRA 2001)

Patient <60 years not on beta blockers	HR increase > 20 bpm SBP increase > 15mmHg
Patient < 60 years on beta blockers	SBP increase >15 mmHg
Age > 60 years	HR increase > 9bpm SBP increase >15mmHg
Under GA	HR increase >8bpm SBP increase > 13mmHg

Table 1: ASRA Criteria: Local anaesthetic test dose

- Intrathecal placement is identified by the presence of motor blockade involving the great toe.

ULTRASONOGRAM

Ultrasonogram is based upon the principle of piezoelectric effect.[16]

- In 1880, the principle of piezoelectric effect, using natural quartz was discovered by the **Curies**

- Applied in use for Diagnostic Medical applications since late 1950 .John Wild first used ultrasound to access the thickness of bowel .He has been considered as the father of medical ultrasonography

- Medical ultrasound imaging uses frequency ranging from 2-15 MHz

- Diagnostic Ultrasound is recognised as safe, effective, and highly flexible form of imaging modality .

- Compared to other prominent imaging modalities it provides images in real time, it is portable and can be used at bedside

Figure 6: Ultrasound machine

PIEZOELECTRIC EFFECT

Piezoelectric Effect is defined as the principle of converting electrical energy into mechanical energy. The reverse of the piezoelectric effect converts the mechanical energy back to electrical energy.

ULTRASOUND TRANSDUCERS

- A transducer is a device that converts one type of energy into another.
- Based upon the pulse-echo principle, transducers convert:

  a. Electrical energy into sound called **pulse**

  b. Sound into electrical energy called **echo**

PULSE

- Pulse is the sound wave which is sent to the soft tissues. Interaction of this sound wave with soft tissue is called “bio effect”. Pulsing is done by the transducer or probe crystals and is not under operator control.

ECHO

- Echo is wave produced by the soft tissues and these waves are received back by the transducer crystals which are then processed and interpreted by the USG machine.

FREQUENCY

- Number of complete cycles per unit of time
- One cycle per second is one Hertz (Hz)

- Commonly used transducer frequencies are:
- 2.5 – 3.5 MHz – for abdomen, obstetrics and gynaecology
- 5.0 – 7.5 MHz – for breast, thyroid
- 7.5 – 10 MHz – for superficial veins, superficial structures

 High frequency gives[17]

– Improved resolution with less depth of penetration

– Used for superficial structures

 Low frequency gives

– Poorer resolution with full depth of penetration

– Used for general abdomino-pelvic structures

Transducer frequency in ultrasound machine is predetermined by design.

WAVELENGTH

- It is the distance between consecutive cycles of sound.

BANDWIDTH

- A range of frequencies is called bandwidth. Broad bandwidth transducer comprises of more than one operating frequencies.

AXIAL & LATERAL RESOLUTION

- Spatial Resolution defines how physically close two objects can be yet displayed separately.
  - Axial: along the path of beam
  - Lateral: perpendicular to the path of beam
- Normally used spatial resolution is1.0 mm or less.

MACHINE COMPONENTS

The USG machine has the following components

1. TRANSDUCER [18]

Types:

• Mechanical

– Oscillating

– Rotating

• Electronic

– Linear Arrays

– Curved Arrays

– Phased Arrays

2. RECEIVER

3. MEMORY

4. DISPLAY

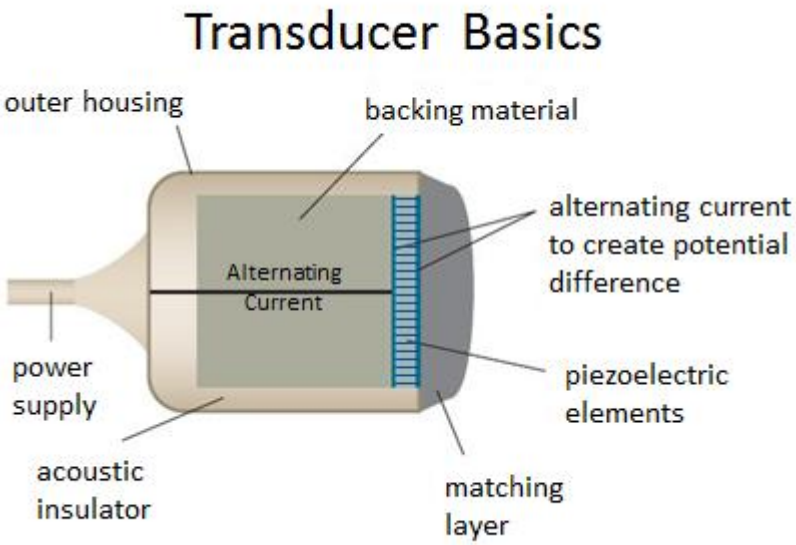

Figure 7: Components of a transducer

FIELD OF VIEW SHAPES

Sector FOV

• Produced by oscillating/ rotating curved arrays, phased arrays

• Typically used in cardiac and abdominal application

Linear FOV

•They are produced by linear arrays

• Classically used in superficial application

PROBE TYPES

- **Curvilinear**: They are Low Frequency Probe

Figure 8: Curvilinear probe

- **Linear**: They are High Frequency Probe

Figure 9: Linear probe

DISPLAY MODES

• **B Mode** - 2 dimensional

Figure 10: B mode image

• **M Mode** - records moving echoes from the heart in display, thus the motion could be interpreted in terms of myocardial and valvular function.

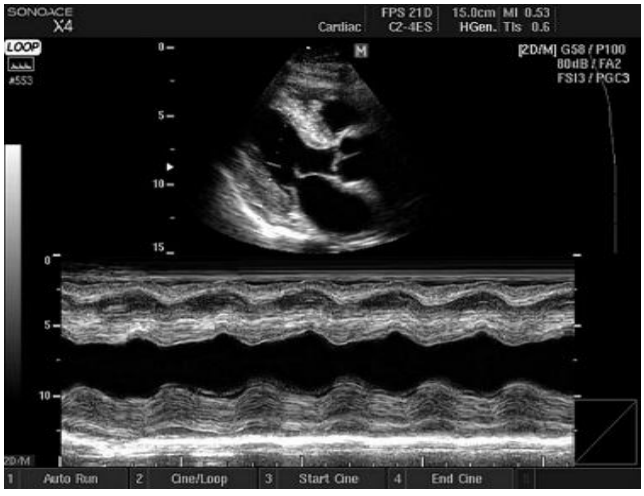

Figure 11: M Mode image

• **Doppler** - here the frequency shift in echo is measured after a certain time.

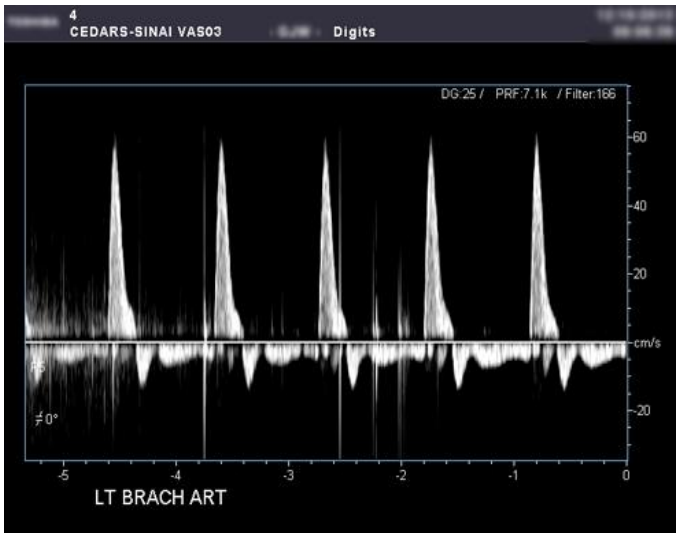

Figure 12: USG Doppler image

• **Colour Doppler** - uses colour corresponding to frequency shift; red for near to and blue for away from the probe.

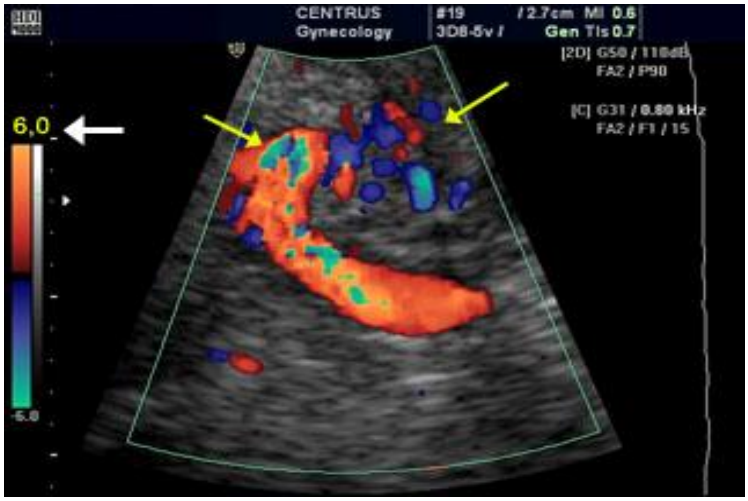

Figure 13: USG Colour Doppler image

RECTUS SHEATH BLOCK – CLINICAL ANATOMY & TECHNIQUES

Schleich first described the use of rectus sheath blocks (RSB) in 1899, with the aim of providing muscle relaxation and analgesia of the anterior abdominal wall by blocking the terminal branches of the thoracolumbar nerves within the substance of the rectus abdominis muscle (RAM).[19]

It was originally performed as a blind, loss-of resistance technique. RSB had previously been under-utilized, largely due to concerns over the precision of needle-tip placement, mainly in relation to vascular structures contained within the rectus sheath as well as visceral structures within the underlying peritoneal cavity.

RSB is ideally suited for ultrasound guidance because the RAM, layers of the rectus sheath, and important vascular structures are easily and accurately identified with ultrasound technology. Rectus Sheath Catheters are designed to be an alternative to epidural analgesia or opioid based IV-PCA by targeting the anterior branches of the intercostal, segmental nerves which supply the abdomen.

- S.M.Yentis described the usage of single injection bilaterally into rectus sheaths for midline incisions for gynaecological surgery which decreased the opioid requirement.[20]

- P.Cornish and A.Deacon first described the technique of surgically placed rectus sheath catheters for pain relief in upper abdominal surgery to decrease perioperative opioids.[21]

- H.Willschke described the technique of USG guidance for rectus sheath blocks in children submitted for umbilical hernia repair.[22]

- D.J.Sandeman and colleagues described the procedure of rectus sheath catheter placement using USG-guidance.[23]

Clinical Anatomy

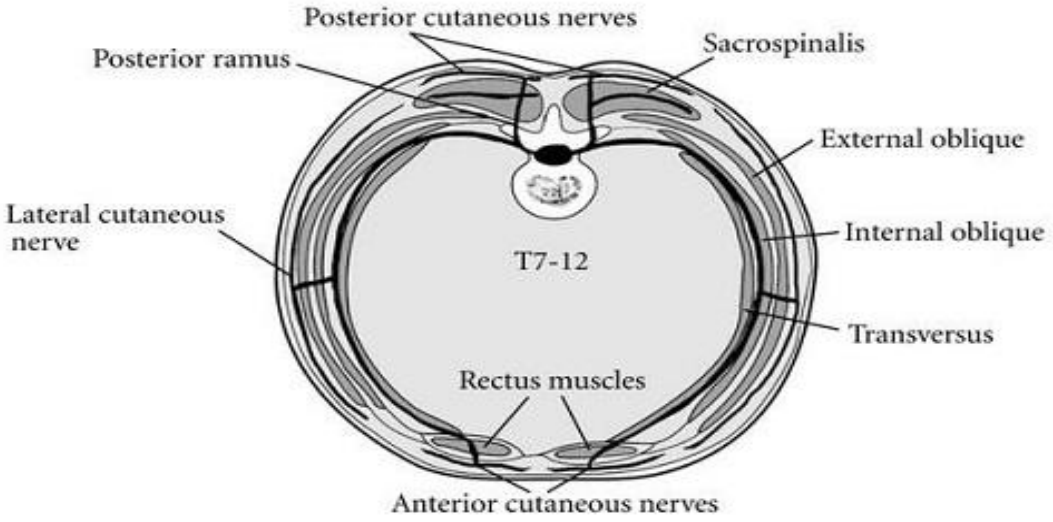

Figure 14: Nerve supply to the abdominal wall

Anatomical course of the thoracolumbar nerves, the sensorimotor innervation of the anterior abdominal wall is supplied by the ventral rami of the thoracolumbar spinal (T7-L1) segmental nerve. The thoracolumbar nerves course along the anterolateral wall within the transversus abdominis plane (TAP), and continue anteromedially within the TAP, eventually encroaching upon the lateral aspect of the rectus sheath. The nerves then enter the lateral aspect of RAM and contribute to the formation of a nerve plexus that runs craniocaudally within the muscle in close proximity to the lateral branch of deep epigastric artery.

The thoracolumbar nerves typically pierce the posterior border (89%) and less commonly the lateral border (11%) of the RAM, with the nerves piercing the posterior border within 1.6 to 2.6 cm from the lateral edge of the RAM. The nerves provide both muscular and cutaneous branches to innervate the muscle fibres and overlying skin. Notably, the branches of the thoracolumbar nerves do not cross midline.

Anatomy of the Rectus Sheath[24]

The rectus sheath is formed from the aponeuroses of the fascial sheaths of all three lateral abdominal wall muscles.

- External oblique (EOM),
- Internal oblique (IOM), and
- Transversus abdominis (TAM) muscles

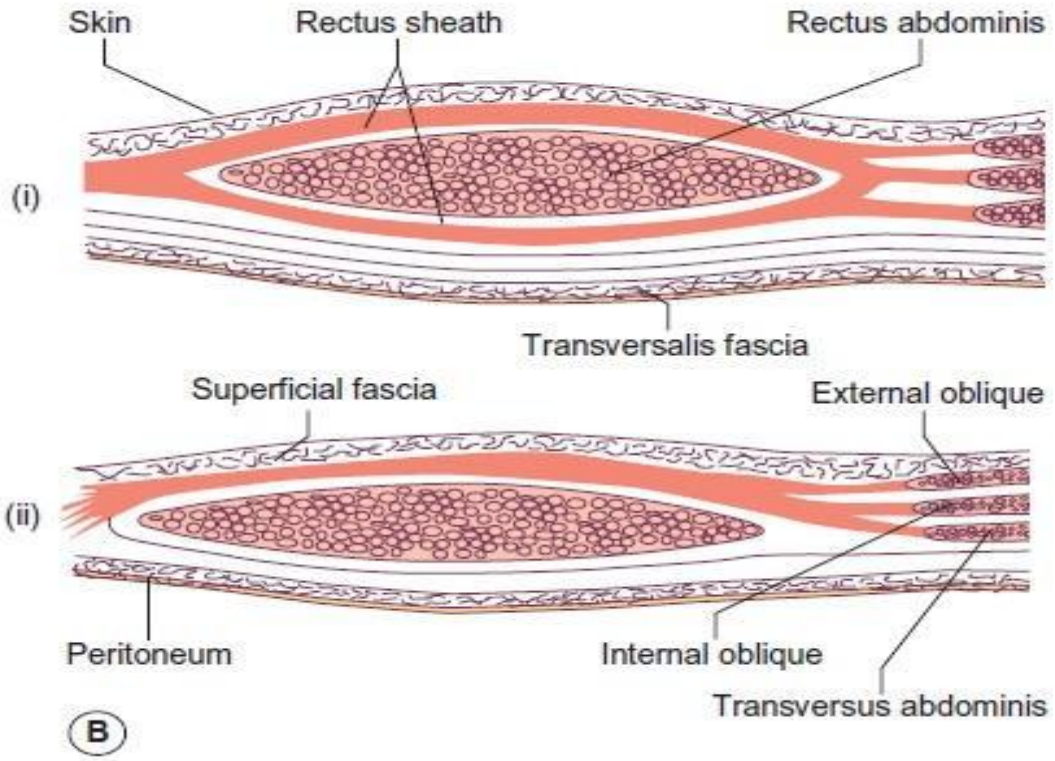

Figure 15: Anatomy of rectus sheath

Each of these muscles form a bilaminar aponeurosis at its medial border converging to form the lateral border of the RAM, termed the Linea Semilunaris. The anterior and posterior lamina of the EOM and the anterior lamina of the IOM fuse together and continue further medially over the ventral surface of the RAM to form the anterior part of the rectus sheath. Similarly, the posterior lamina of the IOM and anterior and posterior lamina of the TAM fuse together and continue medially dorsal to the RAM to form the posterior part of the rectus sheath. At the medial border of the RAM, the anterior and posterior portions of the rectus sheath come together, with the

fibres coursing further medially towards the medial border of the contralateral RAM forming the midline linea alba.

The anterior part of the rectus sheath extends along the entire vertical length of the RAM. In contrast, the posterior part of the rectus sheath extends only along the upper two-thirds of the RAM. In the lower one-third, the posterior part of the rectus sheath stops approximately midway between the umbilicus and symphysis pubis. At this anatomical transition point, the aponeuroses that had formed the posterior portion of the rectus sheath now also course over the ventral surface of the RAM. This transition point is known as the arcuate line. The transversalis fascia is a thin layer of connective tissue located just deep to posterior part of the rectus sheath. Located just deep to the transversalis fascia is the parietal peritoneum. Inferior to the arcuate line, the transversalis fascia is located immediately deep to the posterior border of the RAM. The use of USG guidance increases the success rate of the block, lowers the dose of local anaesthetics, and thereby reduce the complications because of constant visual confirmation. Also, ultrasound guidance avoids the need for surgical placement of catheters intraoperatively which would be difficult to place without significant surgical dissection in the rectus sheaths. Rectus sheath catheter, is a regional anaesthesia technique that provides analgesia to the parietal peritoneum, as well as skin and muscles of the anterior abdominal wall.

SONOANATOMY AND TECHNIQUE

Short-Axis In-Plane Approach

- The transducer, high frequency linear array is positioned just lateral to the umbilicus in an axial (transverse) plane. Identify the layers of the anterior abdominal wall from superficial to deep. A layer of subcutaneous adipose tissue that will vary in depth depending on body habitus.

- Deep to the subcutaneous tissues will be the anterior portion of the of the rectus sheath (a horizontal bright hyperechoic linear structure extending from lateral to medial).

- Deep to the anterior rectus sheath is the RAM (relatively hypoechoic when compared to the rectus sheath).

- Deep to the RAM will be the posterior portion of the rectus sheath (a horizontal bright hyperechoic structure extending from lateral to medial). The deep superior (above the umbilicus) and inferior (below the umbilicus) epigastric arteries may be seen as small, pulsatile, anechoic structures located in the deepest aspect of the RAM. Colour flow Doppler may confirm the presence of blood flow within the arteries.

- Deep to the posterior portion of the rectus sheath will be the transversalis fascia (a hyperechoic linear structure).

- Deep to the rectus sheath and transversalis fascia is the peritoneal cavity, which is identified by the presence of peristaltic movements of the bowel loops.

- The target site for local anaesthetic deposition is deep to the RAM, but superficial to the posterior aspect of the rectus sheath. The terminal thoracolumbar nerves are too small to be visualized as discrete structures; thus, RSB is a “compartment block.”

- Transducer position and initial needle insertion site (lateral to the transducer) should be adjusted in a cephalad-to-caudal manner based on the anticipated location of the vertical midline incision. Placing the transducer in the middle of the anticipated vertical extent of the midline incision should optimize distribution of local anaesthetic spread.

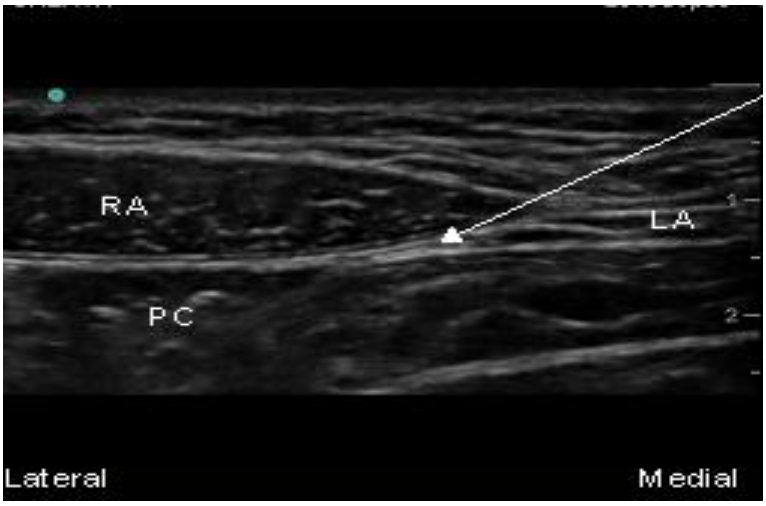

Figure 16: rectus sheath block

Single Injection Technique A 21-gauge, 100 mm (or 20-gauge, 150 mm) needle is inserted 3-8cm lateral to the lateral edge of the transducer and guided "in-plane". The needle is advanced in-plane from lateral to medial and superficial to deep.

The needle should penetrate through the lateral aspect of the linea semilunaris and enter the lateral aspect of the RAM. The needle is further advanced until it is positioned deep to the potential space between the posterior border of the RAM and the posterior rectus sheath.[25]

This target site is referred to as the "Posterior Rectus Sheath Compartment." At this point, a small (1-3 ml) volume of local anaesthetic (or sterile saline) is injected to confirm correct placement within the posterior rectus sheath compartment, indicated by the appearance of an anechoic fluid collection. Subsequently, 15-20 ml of local anaesthetic is incrementally injected while observing for the expanding anechoic fluid collection.

As the local anaesthetic is injected, it will often result in clear separation of the deep border of the RAM from the posterior rectus sheath. Improved local anaesthetic spread may be facilitated by advancement of the needle further medially as the anechoic fluid collection visibly expands the posterior rectus sheath compartment in a lateral-to-medial fashion. After local anaesthetic injection, the transducer is moved in a cephalad-to-caudal fashion to visualize the spread within the posterior rectus sheath compartment. The same procedure is repeated on the contralateral side.[26]

Figure 17: rectus sheath block, single injection technique

Continuous Catheter Technique[27]

• If a continuous catheter technique is desired, the same steps as above are followed except that a 16-gauge Tuohy needle is used and following fluid expansion of the posterior rectus sheath compartment, an 18-gauge catheter is threaded 4-6 cm beyond the needle tip

Figure 18: rectus sheath block; continuous catheter technique

The location of the catheter tip may be confirmed by direct visualization of the catheter or by visualization of local anaesthetic spread within the posterior rectus sheath compartment following the injection of local anaesthetic through the catheter. The needle is withdrawn and the catheter is secured to the skin and covered with a sterile clear transparent dressing.[28]

Local Anesthetic Selection

- 15-20 ml ropivacaine 0.25% with 1:400,000 epinephrine
- 15-20 ml bupivacaine 0.25% with 1:400,000 epinephrine per side

- For paediatric patients, the suggested dosing is 0.5 ml/kg (either bupivacaine 0.25% or ropivacaine 0.25% with epinephrine 1:400,000) per side.

Adding epinephrine decreases the local anaesthetic peak plasma concentration (C max), because spread of local anaesthetic will encompass a relatively large surface area for systemic absorption. Based on initial pharmacokinetic studies, the time to peak plasma concentration (T max) is approximately 45 minutes. Thus, the patient need to be observed for potential signs or symptoms of local anaesthetic systemic toxicity for a minimum of 45 minutes after completion of RSB.

The expected duration of RSB is approximately 6-10 hours. Thus, there should be an analgesic plan when the analgesic effects of the single shot RSB wears off.

For a continuous catheter technique, a small continuous infusion (2-3 ml/hr) is recommended simply to keep to catheter tip patent. Intermittent bolus injection of 10-20 ml ropivacaine or bupivacaine 0.25% per side every 6-10 hours is recommend to maintain postoperative analgesia.

Complications of rectus sheath block:

- Infection
- Rectus sheath hematoma

- Inadvertent intravascular injection
- Bowel injury
- Local anaesthetic toxicity

Strict aseptic precaution, ultrasound guidance and careful monitoring of signs of intravascular placement will reduce the risks of rectus sheath block.

Current Role of Ultrasound-Guided RSB

° RSB may be performed prior to the surgical incision to facilitate analgesia immediately after initiation of surgery. They will decrease intraoperative analgesic (opioid) requirements if they are placed before incision.

° Alternatively, RSB may be performed in the immediate postoperative setting as a “rescue block technique” in the event of either unexpected severe postoperative pain after an abdominal surgical procedure or unanticipated failed epidural analgesic technique.

° One of the primary indications for RSB with or without catheters is to provide postoperative abdominal wall analgesia when thoracic epidural analgesia (TEA) is contraindicated. One potential advantage is the notable lack of sympathectomy (and hypotension) that is commonly associated with TEA.[29]

PHARMACOLOGY OF BUPIVACAINE

Bupivacaine is an amide local anaesthetic formed by addition of butyl group to the piperidine nitrogen of mepivacaine. It was synthesized by A.F.Ekenstam in 1957 and came into clinical use since 1963. It contains equal proportions of 'S'&'R' enantiomers and thereby a racemic mixture is obtained.

Chemical Structure

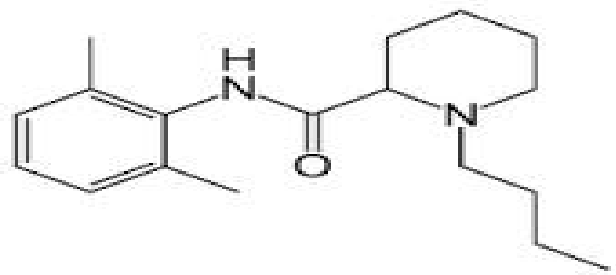

Figure 19 : Structure of Bupivacaine

1- butyl N- (2, 6 dimethyl phenyl) -2-piperidine

dacarboxamide hydrochloride monohydrate

Physicochemical Profile

- Molecular weight - 288.
- pKa - 8.1.
- Plasma protein binding - 95%

- Lipid solubility - 28.
- V_d – 71 litres
- Clearance - 0.472 litres/min
- Onset - Slow
- Duration - 240 – 480 min
- Toxic plasma concentration - 240-480min
- Elimination Half Life - 210min

Mechanism of action:

- They produce conduction blockade by selectively binding to alpha subunit of sodium channel, in an activated closed state, and prevent their change to rested closed and activated open state there by preventing the conduction of impulses and action potential.
- In addition to sodium channels bupivacaine blocks voltage dependent Potassium channels and this leads to broadening of action potential.
- Bupivacaine also blocks the L type calcium channels.
- In addition bupivacaine blocks both types of pain fibres myelinated A – Delta and C fibres. Preganglionic-B fibres are readily blocked by local anaesthetics.

Pharmacodynamics

Bupivacaine has a stabilizing action on all the excitable membranes. So in the cardio vascular system it causes a reduction in automaticity and in the nervous system restlessness, tremors and convulsions occur on over dosage. It is more potent than lignocaine, the sensory blockade is more than the motor blockade.[30]

Pharmacokinetics

Bupivacaine is a weak base that has a pKa value above the physiological pH and therefore only a small fraction of the drug is in ionized form. It is rapidly absorbed from the site of injection. Plasma concentration depends on the route of administration (5 -30min), distribution and rate of clearance. The lungs are capable of extracting bupivacaine from the systemic circulation and its first pass pulmonary extraction is dose dependent.

Metabolism

Bupivacaine binds to the plasma protein alpha-1-acid glycoprotein. It undergoes aromatic hydroxylation, N dealkylation, amide hydrolysis & conjugation. Pipecolylxylidine is the product of metabolism. Renal diseases will not affect the kinetics of bupivacaine as only < 10 -15% of the drug is excreted unchanged in urine.

Uses of bupivacaine[31]

- For central neuraxial block (Spinal epidural and caudal)
- Peripheral nerve block
- Infiltration anaesthesia

Preparations available

0.25%, 0.5% in vials (10ml) (20ml) 5mg/ml + dextrose in 4ml ampoules,

Maximum permitted dose 3mg/ml for 0.25 - 0.5% Bupivacaine

Maximum 400mg/ 24 hours for 0.75% Bupivacaine

Maximum 20 mg for 0.5% Hyperbaric Bupivacaine

Side effects

- Allergy
- Pruritus
- Urticaria
- Angioneurotic edema
- Accidental intravascular injection.

- CNS toxicity:
    - tinnitus
    - vertigo
    - drowsiness
    - muscle twitches,
    - slurred speech,
    - seizures
    - Coma.
- Cardiac toxicity:
    - Hypotension
    - Arrhythmia
    - Atrioventricular block
    - Ventricular tachycardia
    - Ventricular fibrillation
- Hepatotoxicity

REVIEW OF LITERATURE

1) Bashandy et al, 2014 [32]

In this study Bashandy observed the efficacy of a pre-emptive single-injection rectus sheath block in providing better postoperative pain scores compared to general anaesthesia alone.

Sixty patients undergoing midline abdominal surgeries were included in this randomized controlled study. The patients were allocated into two groups: RSB group had a rectus sheath block just after induction of anaesthesia and before the surgical incision, and general anaesthesia group had general anaesthesia alone. Visual analogue scale score (VAS), opioid requirement and hemodynamic parameters in the postoperative period were compared in the two groups for 48 hours.

Results showed the median VAS score to be significantly reduced in RSB group compared with GA group in the postoperative period ($P < 0.05$). Morphine consumption was much lower in RSB group than GA group patient in the first two postoperative days

The study concluded that Ultrasound-guided rectus sheath block is an easy technique to learn. This technique, when used with general anaesthesia, is an effective means of decreasing pain scores and opioid requirement compared with the general anaesthesia alone.

2) Manassero et al, 2015 [33]

This study was a prospective study conducted to examine the local anaesthetic (LA) spread and its effectiveness for surgical anaesthesia of rectus sheath block (RSB) under ultrasound guidance, in adult patients undergoing umbilical hernia repair.

30 patients received a bilateral US-guided injection of 20 ml levobupivacaine 0.375% + epinephrine 5 μg/ml at T-10 level. Anaesthetic spread into the rectus sheath was evaluated using ultrasound at T-9 and T-11 levels and scored from 0 to 4. The RSB was defined effective for surgical anaesthesia if it was able to produce an anaesthetic level sufficient for surgery without any mepivacaine supplementation.

Results showed that the block was effective for surgical anaesthesia in 53.3% of patients (95% confidence interval, ±17.8). In the remaining patients, anaesthesia supplementation was needed at cutaneous incision, whereas manipulation of the muscle and fascial planes was painless. No patients required general anaesthesia. LA spreads as advocated (to T-9 and to T-11 bilaterally = spread score 4) in 8/30 patients (26.6%); in these cases, the block was 75% effective for surgery. The anaesthetic spread was most negatively influenced by increased body mass index. Postoperative analgesia was excellent in 97% of patients.

The study was concluded that the use of RSB as an anaesthetic management of umbilical hernia repair is recommended with an anaesthetic supplementation at the incision site.

3) Wilkinson et al, 2014 [34]

Rectus sheath block using rectus sheath catheter may provide a newer approach to somatic pain without the related adverse effects of epidural analgesia. The trial aimed at comparing the effectiveness of these two techniques in terms of analgesia, patients' overall experience, postsurgical functional recovery, cost-effectiveness and safety.

The study was a single-centre randomised controlled non-blinded trial, which included qualitative study. Over a period of two-years, 132 patients undergoing abdominal surgery through a midline incision were randomised to receive either Epidural analgesia or rectus sheath block for post-operative pain relief. The primary outcome was to enumerate pain scores using VAS on movement from lying to a sitting position at the end of 24 hours postoperatively, and the overall patient experience between the groups were evaluated. Secondary outcomes comprise pain scores at rest and on movement at various time intervals, opioid requirement and functional recovery.

This randomised controlled trial comparing epidural analgesia to USG guided rectus sheath catheters in adults undergoing midline laparotomy is

underway. This a comparison between these pain packages and not just two analgesic approaches, in order to establish if rectus sheath catheter is a viable alternative to epidural analgesia.

4) Dilek Ozcengiz et al, 2012 [35]

In paediatric patients regional techniques are gaining popularity and are used in surgeries such as repair of umbilical and epigastric hernia, laparoscopic surgery and other surgeries involving midline incisions to provide adequate analgesia.

The aim of this study was to assess the effectiveness and side effects of the rectus sheath block with a control group that received intravenous tramadol, for analgesia after major abdominal surgery in paediatric patients. Sixty children who underwent laparotomy were included in this study. Patients were divided in two groups of 30 each: group R patients who had rectus sheath block with 0.25% levobupivacaine and group T, control patients who received intravenous tramadol with normal saline injections into rectus sheath. CHEOPS scale for pain assessment and sedation scores were enumerated at 5, 15, 30, 60 minutes and 2, 6, 12, 24 hours.

Results showed the mean total tramadol used by the levobupivacaine and the normal saline groups in the first 24 h were 0.95 mg/kg and 4.07 mg/kg. There was no significant difference between the groups in terms of CHEOPS pain score and sedation score. In terms of postoperative nausea and

vomiting, analgesic consumption and the analgesic duration the rectus sheath block was superior to intravenous tramadol in children undergoing major abdominal surgery .

5) Willschke et al, 2006 [36]

The purpose of this study was to evaluate anatomically and clinically the ultrasound-guided rectus sheath blocks in children. A total of 30 children were included in the sonoanatomical part of the study. After induction of general anaesthesia children received a rectus sheath block under real-time USG guidance by injecting 0.1 ml /kg of 0.25% levobupivacaine on both sides in the space between the posterior rectus sheath and the rectus muscle.

Visualization of the posterior rectus sheath using ultrasound was clearly possible in all the children. The association between the depth of the posterior rectus sheath to the weight, height and body surface area was poor. The ultrasound guided rectus sheath block provided adequate analgesia in all children and no additional analgesia was required in the perioperative period.

The study concluded that the bilateral rectus sheath using 0.25% levobupivacaine 0.1 ml/kg under ultrasound guidance provides appropriate analgesia for umbilical hernia repair. The depth of the posterior rectus sheath which was highly unpredictable in children favours the use of real time ultrasound in rectus sheath block.

6) AR Godden et al, 2013[37]

Epidural analgesia has been the accepted gold standard modality for postoperative analgesia in open abdominal surgery. Yet, there is significant risk associated with epidural analgesia. The study was a retrospective analysis aimed to review the effect of EA (Epidural Analgesia) and ultrasound guided rectus sheath catheters (RSC) on analgesia and postsurgical complications following open colorectal cancer surgery.

A three-year retrospective review of case details was undertaken of all patients who underwent open colorectal cancer surgery who had either EA or RSC for postoperative pain relief.

The case notes of 120 patients were reviewed retrospectively: 85 patients had EA and 24 RSC while 11 patients were excluded from the study. The EA group experienced a significantly higher incidence of hypotension than the RSC group on the first postoperative day (p=0.0001). Statistically there was no significant variations in pain scores or opioid sparing properties between the two groups (p=0.92). There was no difference in postoperative pulmonary infection, wound infection or anastomotic leaks between the groups. The RSC group had a higher incidence of postoperative ileus than the EA group. However, the sample size were too small to draw a reliable conclusion.

The study concluded that the use of ultrasound guided RSC demonstrated effective postoperative analgesia equivalent to EA with the potential benefits of a reduced incidence of hypotension.

7) Wilkinson KM et al 2014

Rectus Sheath Catheters (RSC) allow infiltration of local anaesthetic into the posterior rectus space. This provides analgesia for midline incisions without the side effects associated with other forms of pain relief.

Wilkinson presented a case of RSC use following emergency surgery. A 53-year old woman presented with small bowel obstruction. She developed SIRS with lactic acidosis and an acute kidney injury. Emergency laparotomy and bowel resection were performed. Postoperatively the patient remained unstable and was transferred to the intensive care unit for overnight ventilation. The following morning, hemofiltration was instituted due to anuria and rising creatinine. Heparin was used for anticoagulation. A decision was taken to utilise RSC for post-operative analgesia and these were inserted under ultrasound guidance. An initial bolus of 40ml of 0.375% bupivicaine was followed by 0.2% ropivicaine via a pump (10mls/hour with an additional PCA bolus of 10mls available 4-hourly). 10mgs of intravenous morphine was then given to cover any visceral pain, sedation was discontinued and the patient was successfully extubated one hour later. Regular paracetamol and a 25μg fentanyl patch were also prescribed. Results Analgesia was excellent-the

maximum recorded pain score with the catheters in situ was 2/10. A single adjuvant dose of iv morphine was required on day 3. Recovery progressed well and the RSC were removed on day 4.

This case highlights several contraindications including sedation, haemodynamic instability, infection and coagulopathy. Opiate-based regimes can also be used after emergency surgery. However, systemic opiates have been shown to be less effective than epidurals and are associated with a higher incidence of complications such as ileus. The choice of analgesic regimen after emergency laparotomy can be difficult, but this case highlights that RSC can be a safe and effective option.

8) Wada M et al,2012 [38]

A rectus sheath block provides postoperative pain relief for midline abdominal incisions. However, there is a lack of details about the pharmacokinetic effects of local anaesthetic used in such type of blocks. In this study, the time course of ropivacaine concentrations after rectus sheath block is studied. 39 patients undergoing elective lower abdominal surgery were allocated to three groups receiving rectus sheath block with 20 mL of different concentrations of ropivacaine. Peak plasma concentrations were dose dependent, and there were no significant differences in the times to peak plasma concentrations. The present data also suggested a slower

absorption kinetics profile for ropivacaine after rectus sheath block than other compartment block.

9) Yakoshi et al 2014 [39]

The study was conducted to assess the analgesic effectiveness and safety of rectus sheath block combined with intraperitoneal instillation using two doses of ropivacaine in patients undergoing laparoscopic gynecological surgery.

53 consenting women were randomized to receive intraperitoneal infiltration with 0.25% ropivacaine or 0.5% ropivacaine followed by rectus sheath block with 0.375% ropivacaine. The outcomes of clinical safety were measured using plasma concentration of local anaesthetics and occurrence of any toxic symptoms. The analgesic efficacy was assessed by using VAS score for pain and morphine consumption in the first 24 hours postoperatively.

Result showed patients' baseline characteristics, surgical factors, and analgesic outcomes were comparable between the two groups. Although peak plasma concentration of ropivacaine was significantly higher in patients receiving 0.5% ropivacaine, but none of the analysed concentrations were above the toxic limits. Besides, no patients showed any symptoms of local anaesthetic toxicity.

The study showed that the combination of rectus sheath block with intraperitoneal instillation of ropivacaine was safe and potent enough in relieving postoperative pain after laparoscopic surgery.

10) Osaka et al, 2011

Obstructive ileus is a life-threatening gastrointestinal condition that requires emergency surgery. Patients with obstructive ileus may develop coagulopathy. In such cases, central neuraxial blockade should be avoided. Rectus sheath blockade (RSB) is one of the popular methods for abdominal wall surgery. Ultrasound imaging of the rectus sheath may facilitate successful RSB by indicating the presence and location of rectus abdominis. Two patients presented with ileus secondary to rectal or sigmoid cancer and underwent emergency ileostomy. The patients had mild coagulopathy [platelet count, 77,000 /ml^3 in case 1, and platelet count, 98,000 ml^3 in case 2]. Each patient underwent general anaesthesia using propofol and remifentanil. They were given 0.5% ropivacaine 20ml for RSB under ultrasound-guidance. Their hemodynamics was stable and they did not need another muscle relaxant during operation, except succinylcholine during induction. RSB is useful for abdominal operations. In addition, ultrasonograhphy facilitates the prediction of depth of the posterior rectus sheath and improves the accuracy of local anesthetic placement. We conclude that RSB is effective for improving postoperative

pain and intraoperative muscle relaxation of the abdominal wall. Ultrasound-guided RSB is an alternative method to central neuraxial blockade.

11)Thomas J Dutton et al, 2014 [40]

This study was conducted in patients undergoing open midline urological surgeries to study the safety and efficacy of rectus sheath blocks by placing bilateral rectus sheath catheters.

Under ultra sound guidance rectus sheath catheters were placed in 200 patients for whom 106 patients underwent radical retropubic prostatectomy(RRP) and 94 underwent open radical cystectomy.

Retrospective review was undertaken, outcomes included technical success and complication rates of the insertion and use of RCS, visual analogue score, additional analgesia requirement and length of hospital stay. Result showed all RCS were successfully placed without complications and though overall pain scores in both the groups.

The study concluded that the use of RCS appear to be effective and safe method of perioperative analgesia in patients undergoing major open urological surgeries.

MATERIALS AND METHODS

This study was conducted at Government Stanley Medical College hospital, Chennai on 100 patients who underwent midline laparotomy surgery. This study was conducted after obtaining approval from the institutional ethical committee. Patients were explained about the procedure in detail and informed written consent was obtained for the same.

Study Design:

This study is a randomized prospective interventional clinical trial. Randomisation was done by allocating the patients to either the Rectus Sheath Block group (Group RSB) or Thoracic Epidural Analgesia group (Group TEA) by draw of lots. Study was an observer blinded study. The patients who met the inclusion and exclusion criteria were only included in the study. Patients were divided into two groups of 50 each.

Group RSB: Patients receiving Rectus Sheath Block

Group TEA: Patients receiving Thoracic Epidural Analgesia.

SAMPLE SIZE:

t tests - Means: Difference between two independent means (two groups) Analysis: A priori: Compute required sample size

Input: Tail(s) = Two

Effect size d = 0.57

α err prob = 0.05 Power

(1-β err prob) = 0.80

Allocation ratio N2/N1 = 1

Output: Non-centrality parameter δ = 2.8500000

Critical t = 1.9844675

D_f = 98

Sample size group 1 = 50

Sample size group 2 = 50

Total sample size = 100

Actual power = 0.8056577

Sample size was drawn using the above observation.50 patients in each of the two groups: Group RSB and Group TEA were included.

SELECTION OF CASES:

Inclusion Criteria:

All consented patients with

- Age: 18 to 65 years
- Both genders
- Weight: ≥ 50 Kg
- ASA: 1, 2 and 3.
- Midline laparotomy surgery

Exclusion Criteria:

- Patients with known hyper sensitivity to local anaesthetics.
- Patient refusal
- Abnormal coagulation status
- Severe systemic illness
- Planned transverse or oblique abdominal incision
- Skin lesion at site of blockade
- Pre-existing chronic pain abdomen
- Pregnancy

Material Required:

- Monitor: NIBP, ECG, Pulse oximeter.
- Resuscitation drugs and equipment.
- Anti-septic skin preparation and sterile gloves.
- Ultrasound machine (eSOATE) with high frequency (6-12 MHz) linear probe.
- Ultrasound gel.
- Epidural needle/catheter set.
- 2 ml, 5ml, 10ml syringes.
- Adhesive tapes.
- Drugs:
    - Injection Midazolam
    - Injection Glycopyrrolate
    - Injection Fentanyl
    - Injection Propofol
    - Injection Vecuronium
    - Injection Neostigmine
    - Desflurane
    - Injection Bupivacaine 0.5% plain
    - Injection Tramadol
    - Injection Ondansetron

STUDY METHOD

Procedure:

All the patients subjected to study were assessed in our pre-anaesthetic assessment clinic. Patients satisfying the inclusion criteria were only included in the study. Written informed consent was obtained from the patient.

Patients were randomly allocated into 2 groups, each group comprising of 50 patients. Randomization was done by draw of lots by allocating patients either to group RSB (rectus sheath block) or group TEA (thoracic epidural analgesia).

On the day of surgery patient was shifted to the pre medication room. 18 gauge IV line was secured and ringer lactate was started at 2ml /kg /hr. Patient was given premedication with Inj. Glycopyrrolate (0.05 mg/kg) IM and injection midazolam (0.05 mg/kg) IM. Patients were connected to the monitors NIBP, ECG, SpO2 after shifting the patient to the Operation Theatre. All the baseline hemodynamic parameters were noted.

STANDARD GENERAL ANAESTHETIC

All patients in the trial received a general anaesthetic as follows: Inj. Fentanyl 2mcg/kg IV; Inj. Propofol 2 mg/kg; Inj. Vecuronium 0.1 mg/kg intravenously (IV). All patients were intubated under direct laryngoscopy using cuffed endotracheal tube of appropriate size.

Anaesthesia was maintained with Desflurane, initially at 1 MAC (minimum alveolar concentration) then titrated to clinical end points with Oxygen and N2O at 33:66 ratio. Multimodal anti-emesis consisting of Ondansetron 8 mg and Dexamethasone 8 mg intravenously was used.

GROUP RSB (Rectus Sheath Block)

The RSC was inserted bilaterally under ultrasound guidance by the anaesthetist immediately following induction of a standard general anaesthetic. Under aseptic technique using large sterile drapes with large aperture for adequate ultrasound access to abdomen, and under direct ultrasound guidance using portable ultrasound machine with a sheathed linear transducer probe, Linea alba visualised in the upper abdomen. Probe was then moved laterally to visualise the body of the rectus muscle. The posterior rectus sheath and the transversalis fascia were clearly visible as a set of "tramlines" posterior to the rectus muscle. The ventral rami of the intercostal nerves supplying the anterior abdominal wall lie in this potential space between the posterior aspect of the rectus muscle and the 'tramlines'. The ultrasound probe was then rotated into a coronal plane.

An in-plane approach was used to insert a 16G Tuohy needle and was advanced until the tip lied on top of, or just anterior to the 'tramlines' but just posterior to the rectus muscle. When the tip of the needle reached the posterior sheath (tramlines) the correct position was confirmed by injecting a

bolus of normal saline to separate the planes and achieve hydro-dissection. A further 20ml of 0.25% bupivacaine was injected down the Tuohy needle and that further opened up the potential space between the rectus muscle and posterior rectus sheath, allowing the 18 gauge epidural catheters to be inserted.

The hydro-dissected space and catheters were easily visible on ultrasound confirming their correct positioning. The epidural catheter was then threaded through the Tuohy needle and about 6-8 cm of catheter was inserted into the space and the Tuohy needle was removed. The catheter was secured to the skin with adhesive tape. The procedure was repeated on the opposite side.

Approximately 45 minutes before the end of surgery Inj. Paracetamol 1000 mg was administered intravenously to provide visceral analgesia. After extubation, an intermittent bolus of 20ml of 0.25% bupivacaine was administered every 6 hourly through each rectus sheath catheter.

If breakthrough pain was experienced, Inj. Tramadol 100 mg intravenous bolus was given and repeated as required for further breakthrough pain within the first 48 hours.

GROUP TEA--- (THORACIC EPIDURAL ANALGESIA)

Epidurals were sited prior to the induction of general anaesthesia. Standard aseptic insertion technique was followed. The approach used was midline. Patient in right lateral position, Epidural space was identified using loss of resistance (LOR) to air 18G Tuohy needle was used for identification of epidural space. The Tuohy needle is introduced at T_{10}-T_{11} interspace with intermittent compression[57] of the syringe plunger attached to the Tuohy needle. As the needle is advanced through supraspinous, interspinous ligaments and ligamentum flavum there will be a bouncing movement of the plunger. As soon as the ligamentum flavum is pierced resistance to syringe plunger is lost and epidural space identified at 3 – 5cm from skin level. An epidural catheter was threaded into the epidural space via the epidural needle and catheter was fixed so that 5 cm of the catheter was in the epidural space. Tip of the catheter were placed at T8-T9 level. Following a suitable test dose, a bolus of 10 ml 0.125% bupivacaine was administered to establish the block.

Approximately 45 minutes before the end of surgery Inj.Paracetamol 1000 mg was administered intravenously. Following extubation, an intermittent bolus injection of 0.125% bupivacaine was given epidurally 6 hourly for 48 hours post operatively.

If breakthrough pain was experienced, then Inj .Tramadol 100 mg intravenous bolus was given and repeated as required for further breakthrough pain within the first 48 hours.

OUTCOMES MEASURED

Primary Outcome measured:

Assessment of postoperative pain by Visual Analogue pain score.

Secondary Outcome measured:

a. Postoperative Nausea and vomiting

b. Rescue Analgesic requirement

c. Patient Satisfaction

d. Therapeutic /Technical failure rate

Formats of numerical rating and visual analogue scales.

VAS scores:

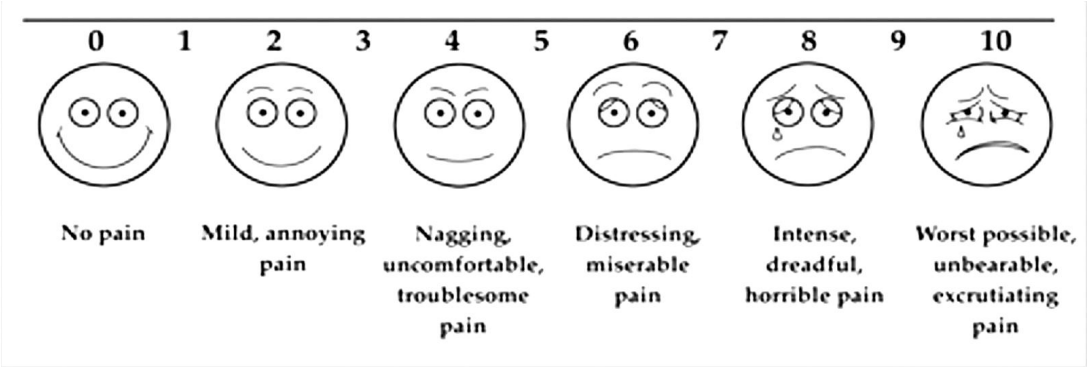

Figure 20 : VAS Scores

Visual analogue pain scores were measured on a 0-10 cm scale. VAS score of "0" indicates "no pain", at a score of 4 patient will be uncomfortable and at a score of 10 patient will have unbearable pain (fig.17). VAS scores were measured at 15, 30, minutes and 2, 4, 8, 16, 24, 30, 36 and 48 hours after surgery. When VAS scores are greater than or equal 4, Injection tramadol 100 mg was given intravenously preceded by Injection Ondansetron 4mg IV.

Secondary Outcome measures:

a. Postoperative nausea and vomiting:

Patients were assessed for nausea and vomiting by nausea scores

None	0
Mild	1
Moderate	2
Vomiting	3

Rescue anti-emetics were given to patients with nausea score greater than are equal to 2 with Injection Ondansetron 4mg

b. Patient Satisfaction:

Patient satisfaction was assessed based on their postoperative analgesia at the end of 48 hours.

Poor	1
Fair	2
Good	3
Excellent	4

c. **Therapeutic failure** is defined as inadequate pain relief from surgical wound and drains.

d. **Technical Failure** is the inability to insert TAP catheter/epidural catheter as a result of poor tissue planes.

e. Requirement of rescue analgesia: If the postoperative pain scores as measured by visual analogue scale is greater than or equal to 4, then rescue analgesia of intravenous tramadol 100mg was given.

FLOW CHART OF EVENTS

1. Written informed consent obtained and patients were explained about the procedure
2. Patient was shifted to premedication room
3. Monitors connected (NIBP, ECG, Pulse oximeter)
4. Baseline parameters were noted.
5. 18G intravenous line was secured.
6. Ringer Lactate infusion 2ml/kg/hour started
7. 0.5mg/kg Midazolam and 0.04mg/kg Glycopyrrolate was given intramuscularly as premedication
8. TEA group patients were positioned – Right Lateral position.
9. Back prepared with Betadine and draped
10. Epidural space identified by LOR technique and catheter fixed at T_8-T_9 level
11. Patients in both the group general anaesthesia with endotracheal tube using Inj. Fentanyl 2mcg/kg, Inj. Propofol 2mg/kg, Inj. Vecuronium 0.1mg/kg was given.

12. After induction patients in RSB group, an ultrasound guided rectus sheath catheter was placed bilaterally and 20ml of 0.25% bupivacaine given on each side

13. Intra op vitals monitored. About 45 min prior to the completion of surgical procedure Inj. paracetamol 1000 mg intravenously was given to patients in both groups.

14. Patients from group RSB were given 20 ml of 0.25% bupivacaine via rectus sheath catheter at the end of the procedure and continued as 6 hourly intermittent bolus.

15. Patients from group TEA received 10 ml of 0.125% bupivacaine via epidural catheter at the end of the procedure and continued as 6 hourly intermittent bolus.

16. Primary outcome measures were numerical rating pain scores/VAS scores on a 0-10 cm scale. Scores measured at 15 minutes, 30 minutes, 2 hours, 4, 8, 16, 24, 30, 36 and 48 hours after surgery.

17. Patients were monitored for side effects of the procedure. They were monitored for technical / therapeutic failure.

18. In case of failure (Technical/Therapeutic), rescue analgesia is with injection Tramadol 100 mg through the intravenous route.

OBSERVATIONS & RESULTS

A randomised controlled study was conducted in Govt. Stanley Hospital to compare the postoperative analgesic efficacy of Ultrasound guided rectus sheath block (RSB) with Thoracic epidural analgesia (TEA) following midline laparotomy surgeries. Sample size was calculated to be 100 patients. The 100 patients were randomly allocated into group RSB and Group TEA by draw of lots on the day of surgery. The observation and results are as follows.

The collected data was analysed with SPSS 16.0 version .To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the Mean and Standard deviation (S.D) were used for continuous variables. To find the significant difference between the bivariate samples in independent groups the unpaired sample t-test was used for normal data and for the skewed data Mann-Whitney U test was used. To find the significance in categorical data Chi-Square test was used. In all the above statistical tools the probability value less than 0.05 is considered as significant level.

DEMOGRAPHIC PROFILE:-

1) AGE: Maximum age in Group RSB was 62 yrs and the minimum age was 30 years. Mean age in group RSB was 48.26 years and the standard deviation was 7.301 years. In Group TEA, the minimum age was 24 years,

whereas the maximum age in Group E was 65 years. Mean age in Group TEA was 46.86 years. These data were computed using student t-test and the P value was found to be 0.407. This difference is considered to be not statistically significant (Table 2, Figure 21)

Age in years	Group RSB	Group TEA	P value
Mean ± SD	48.26±7.301	46.86±9.368	0.407 Not significant

Table 2 : AGE DISTRIBUTION

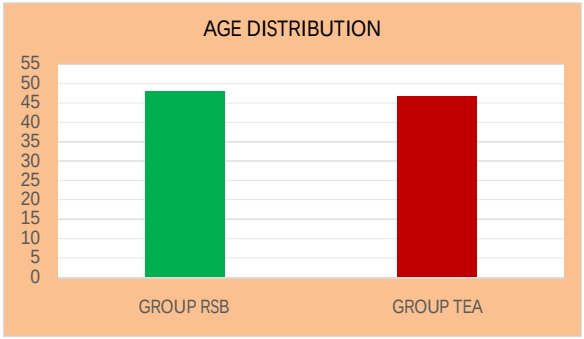

Figure 21: AGE DISTRIBUTION

2) SEX DISTRIBUTION

The number of male patients in Group RSB were 42, whereas the number of female patients were 8. The number of male patients in Group TEA were 37, whereas the female patients were 13 in numbers. The data was computed using chi square test. The two tailed P-value equals 0.220, which is not statistically significant (Table 3, Figure 22,23).

SEX	Group RSB	Group TEA	P value
MALE	42	37	0.220 Not significant
FEMALE	8	13	

Table 3: Gender Distribution

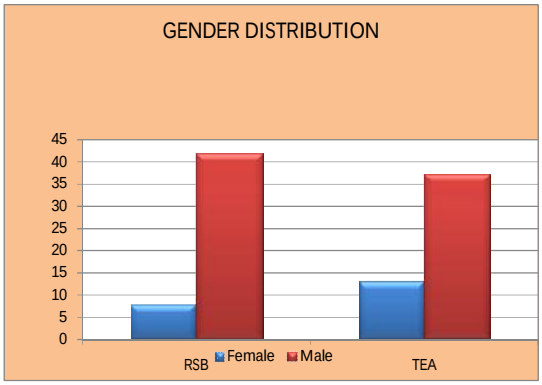

Figure 22: GENDER DISTRIBUTION

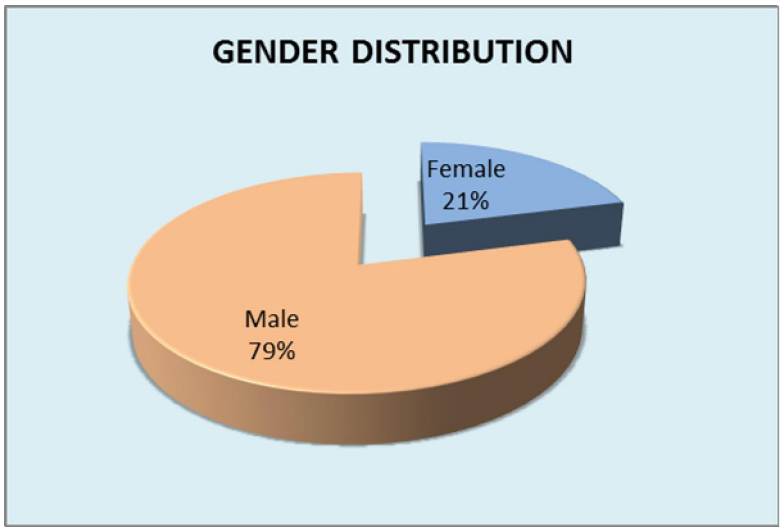

Figure 23: GENDER DISTRIBUTION

3) WEIGHT DISTRIBUTION

Maximum weight of the patient in Group RSB was 90 kg, with a minimum weight of 56 kg. mean weight in was 73.20 kg with a standard deviation of 9.271 kg, maximum weight of group TEA patients was 90 kg and the minimum weight was 55 kg.. Mean weight in Group E was 74.10 kg with a standard deviation of 8.742 kg. Data was computed using student t-test. The P-value equals 0.619, which is not statistically significant (Table 4, Figure 24).

Weight	Group RSB	Group TEA	P value
Mean ± SD	73.20±9.271	74.10±8.742	0.619 Not Significant

Table 4: Weight distribution

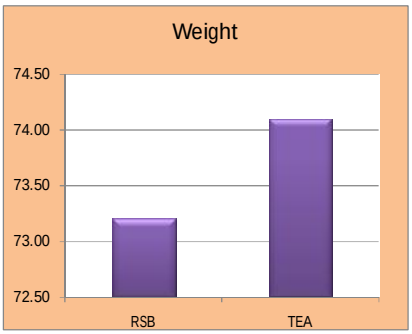

Figure 24: WEIGHT DISTRIBUTION

4) ASA PHYSICAL STATUS

9 patients in Group RSB and 12 patients in Group TEA had physical status of ASA 1. Whereas ASA physical status of 3 was in 11 and 12 patients in Group RSB and Group TEA respectively. P value was statistically not significant. (Table 5, fig.25)

ASA	Group RSB	Group TEA	P value
1	9	12	0.423
2	30	26	
3	11	12	Not significant

Table 5: ASA physical status distribution

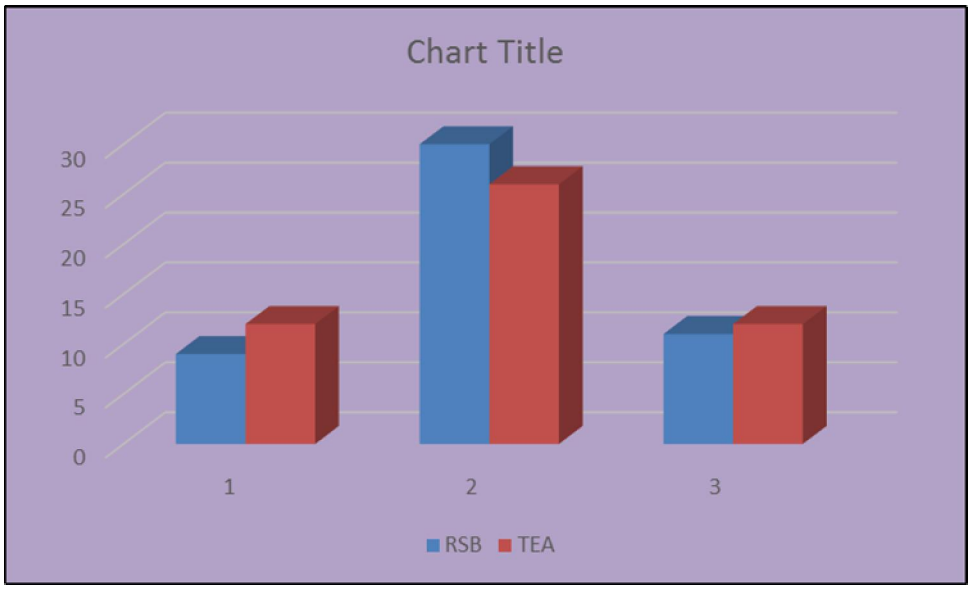

Figure 25: ASA physical status

5) DURATION OF SURGERY:

The average duration of surgery in Group RSB was 144.52 minutes with a standard deviation of 28.456. The mean duration of surgery in Group TEA was 136.70 minutes with a standard deviation of 26.337. The data was computed using student t-test. The p value was 0.157 which was not statistically significant (table 6, figure 26).

Duration	Group RSB	Group TEA	P value
Mean±SD	144.52±28.456	136.70±26.337	0.157 Not significant

Table 6: Duration of surgery

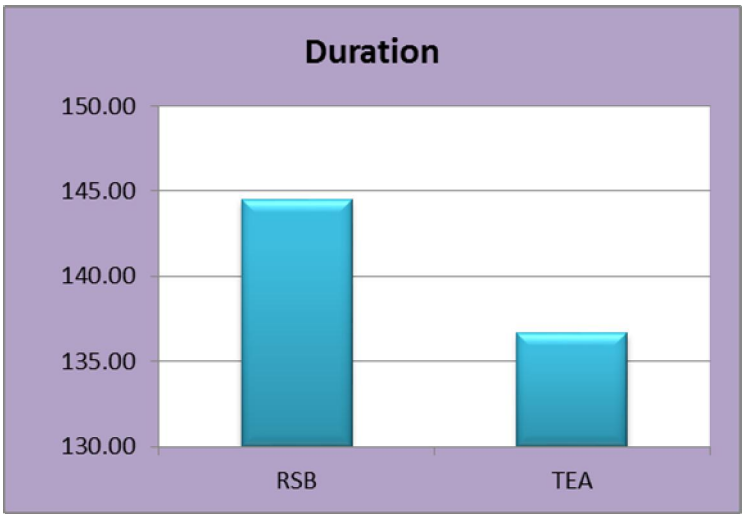

Figure 26: Duration of surgery

6) VAS SCORING:

TIME	GROUP RSB	GROUP TEA	P value
15min	3.12±1.769	2.92±1.510	1.000
30min	3.18±1.976	3.04±1.702	0.788
2hrs	3.14±1.498	2.80±1.429	0.160
4hrs	3.06±1.376	2.82±1.240	0.482
8hrs	3.10±1.389	2.82±0.873	0.571
16hrs	3.08±1.353	2.92±1.066	0.779
24hrs	2.76±1.648	2.44±1.163	0.621
30hrs	2.40±1.294	2.06±0.956	0.153
36hrs	2.80±0.808	2.58±0.609	0.217
48hrs	2.18±1.024	2.24±0.797	0.521

Not Significant

Table 7: VAS Scores

Postoperative pain scores were measured using visual analogue scores in a 0-10cm scale. The visual analogue scores were compared between the two groups, Group RSB and Group TEA, VAS scores were measured at 15minutes, 30 minutes, 2 hours, 4 hours, 8 hours, 16 hours, 24 hours, 30 hours, 36 hours and 48 hours. The visual analogue scores over the entire 48 hours were comparable between the two groups. The average VAS scores at 15 minutes, 30 minutes, 2 hours, 4 hours, 8 hours, 16 hours, 24 hours, 30 hours, 36 hours and 48 hours for both Group RSB and Group TEA are enumerated in table 7 and figure 27.

The p-value between the two groups over the entire 48 hours in the postoperative period was not statistically significant.(table 7, figure 27)

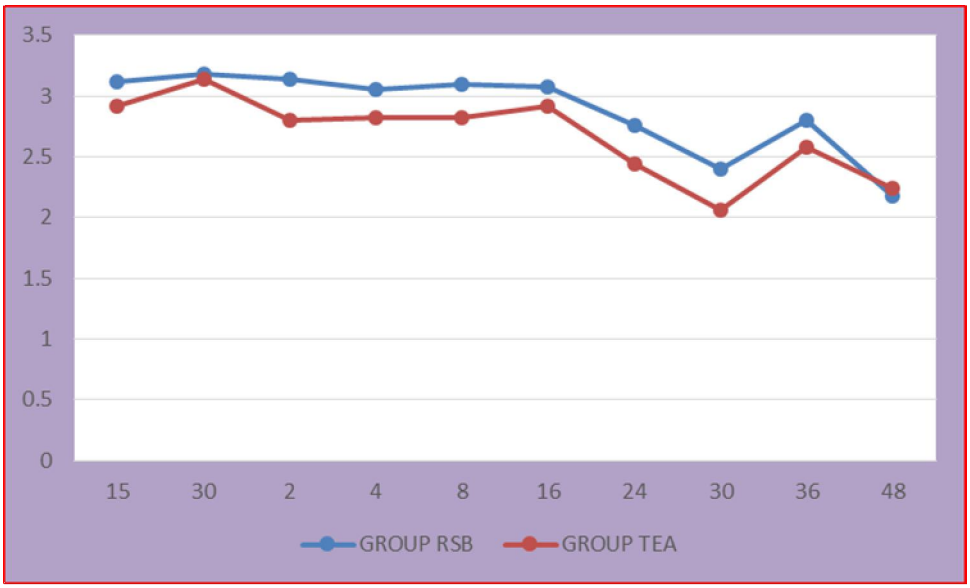

Figure 27: VAS SCORING

7) PULSE RATE:

TIME	Group RSB Mean±SD	Group TEA Mean±SD	P value	Significance
15min	87.72±11.036	83.12±11.689	0.046	Significant
30min	86.86±11.920	83.46±11.920	0.157	Not Significant
2hrs	85.94±9.310	83.56±10.605	0.236	Not Significant
4hrs	84.08±8.305	82.70±9.416	0.439	Not Significant
8hrs	84.36±8.420	81.92±7.811	0.136	Not Significant
16hrs	83.92±8.659	80.56±8.212	0.049	Significant
24hrs	82.42±7.921	80.84±8.904	0.351	Not Significant
30hrs	82.60±7.225	79.60±7.902	0.050	Significant
36hrs	80.92±6.327	78.28±7.088	0.052	Significant
48hrs	81.16±5.108	78.38±5.566	0.011	Significant

Table 8: PULSE RATE

Pulse rate was monitored over a period of 48 hours, in the postoperative period in both Group RSB and Group TEA, at intervals of 15 minutes, 30 minutes, 2 hours, 4 hours, 8 hours, 16 hours, 24 hours, 30 hours, 36 hours and 48 hours.

There was a decrease in pulse rate in Group TEA at all time intervals compared to Group RSB, The p-value was significant at 15 min,16 hours, 30hours, 36 hours, and 48 hours.(Table 18, figure 28).

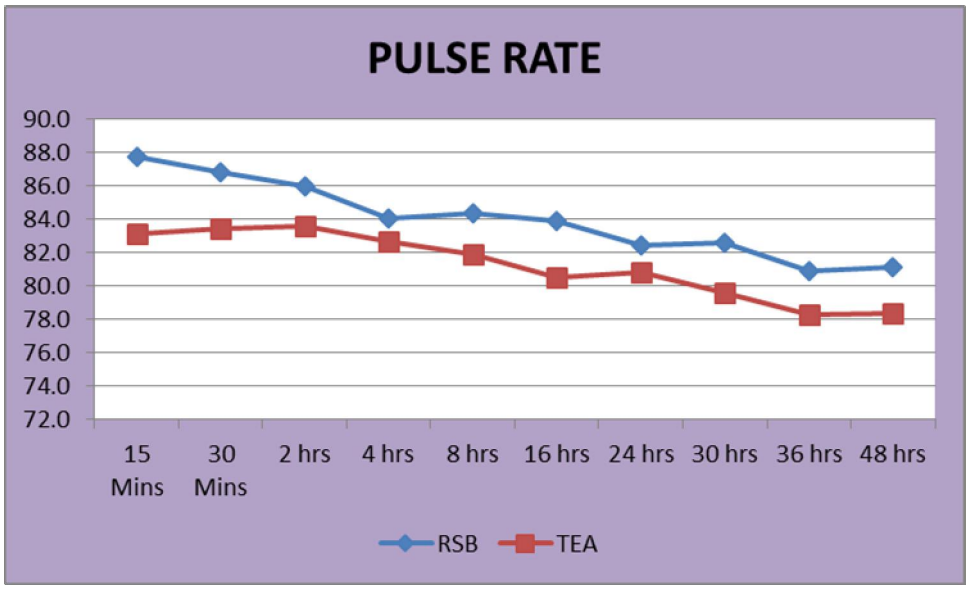

Figure 28: PULSE RATE

8) SYSTOLIC BLOOD PRESSURE:

TIME	Group RSB Mean±SD	Group TEA Mean±SD	P value	Significance
15min	126.00±8.281	122.32±10.539	0.055	Significant
30min	122.08±7.703	113.68±12.655	0.001	Significant
2hrs	121.46±7.195	115.72±10.637	0.002	Significant
4hrs	122.32±6.763	118.40±7.091	0.006	Significant
8hrs	122.94±6.422	118.18±11.215	0.011	Significant
16hrs	122.50±7.731	118.78±7.547	0.017	Significant
24hrs	121.46±7.960	119.58±8.320	0.251	Not Significant
30hrs	122.28±7.326	119.12±8.280	0.046	Significant
36hrs	120.62±6.827	119.7±6.550	0.493	Not Significant
48hrs	120.74±6.931	118.08±5.771	0.040	Significant

Table 9: SYSTOLIC BLOOD PRESSURE

Systolic BP was monitored over a period of 48 hours. There was a significant fall in systolic BP over the entire 48 hours in Group TEA except at 24 and 36 hours as depicted in Table 9 and figure 29. The p-value was found to be statistically significantly at all time intervals.

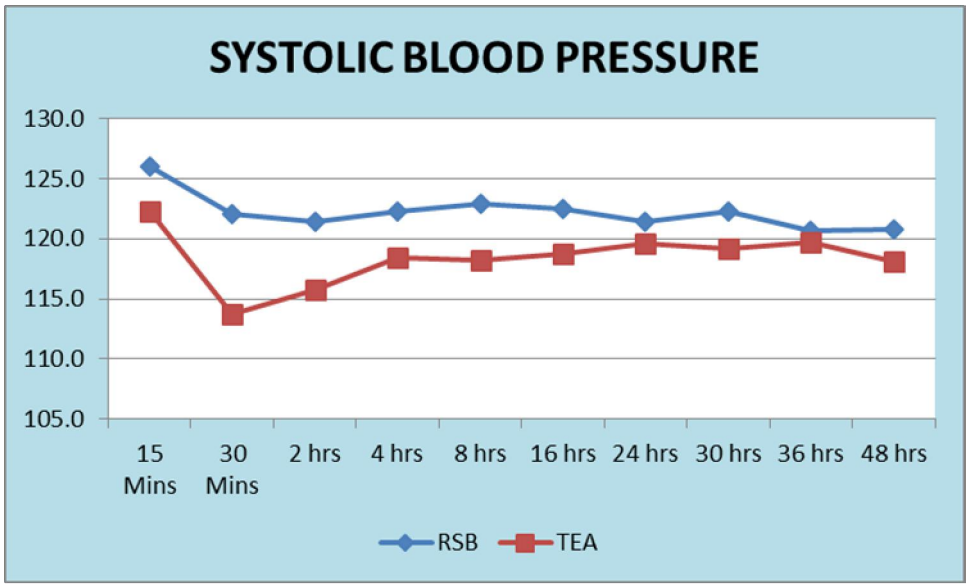

Figure 29: SYSTOLIC BLOOD PRESSURE

9) DIASTOLIC BLOOD PRESURE:

TIME	Group RSB Mean±SD	Group TEA Mean±SD	P value	Significance
15min	74.63±6.85	68.53±3.709	0.664	Not Significant
30min	75.3±7.87	68.76±4.57	0.174	Not Significant
2hrs	75.15±7.47	70±5.52	0.391	Not Significant
4hrs	74±6.74	70.86±3.342	0.610	Not Significant
8hrs	74±6.08	70.86±3.85	0.193	Not Significant
16hrs	74.3±7.00	70.9±3.462	0.336	Not Significant
24hrs	73.16±5.88	71.1±3.94	0.598	Not Significant
30hrs	72.93±5.28	71.08±3.919	0.348	Not Significant
36hrs	73.26±6.06	71.36±3.53	0.785	Not Significant
48hrs	73.65±6.334	71.31±3.74	0.584	Not Significant

Table 10: DIASTOLIC BLOOD PRESURE

Diastolic BP was measured over the 48 hours postoperative period, at specified time intervals. The mean diastolic blood pressure was found to be lower in Group TEA than Group RSB at all time intervals as depicted in Table 10 /figure 30. But the P value was found to be statistically not significant at all time intervals.

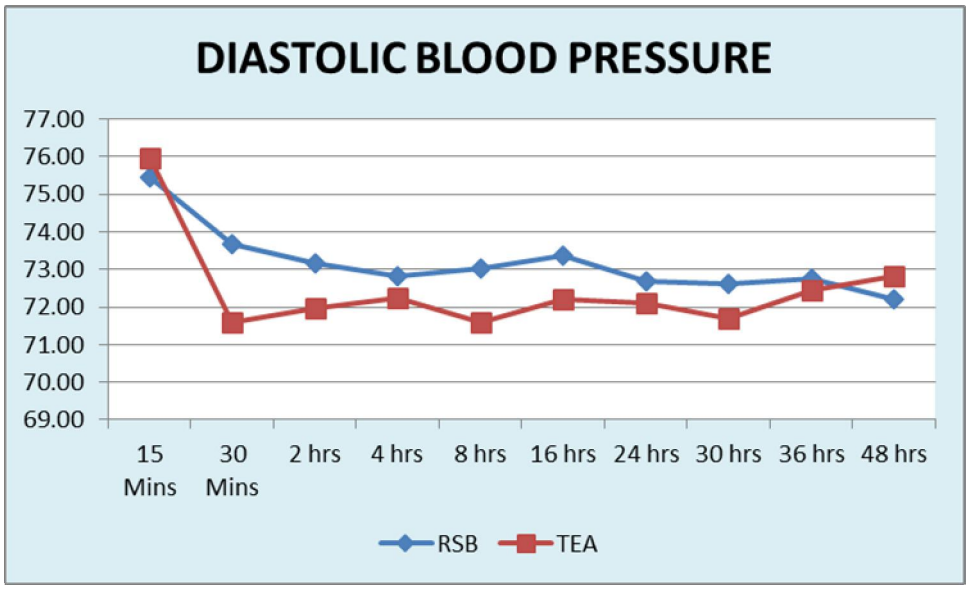

Figure 30: DIASTOLIC BLOOD PRESSURE

10) MEAN ARTERIAL PRESURE:

TIME	GROUP RSB mean±SD	GROUP TEA mean±SD	P value	Significance
15min	92.29±5.48	91.43±6.07	0.455	Not Significant
30min	89.80±6.19	85.61±8.05	0.004	Significant
2hrs	89.27±5.35	86.56±7.30	0.037	Significant
4hrs	89.32±5.17	87.63±4.35	0.080	Not Significant
8hrs	89.66±4.92	87.13±5.32	0.015	Significant
16hrs	89.74±5.42	87.74±4.65	0.050	Significant
24hrs	88.94±4.63	87.94±3.59	0.270	Not Significant
30hrs	89.17±4.10	87.51±4.23	0.048	Significant
36hrs	88.70±4.76	88.21±4.07	0.579	Not Significant
48hrs	88.91±4.80	87.91±3.92	0.580	Not Significant

Table 11: MEAN ARTERIAL PRESSURE

MAP was measured over the entire 48 hours postoperative period, at specified time intervals. The mean arterial pressure was found to be lower in Group TEA than Group RSB at all time intervals as depicted in Table 11/ figure 31. The P – value was found to be statistically significant, at 30 min, 2 hours, 8 hours, 16 hours and at 30 hours.

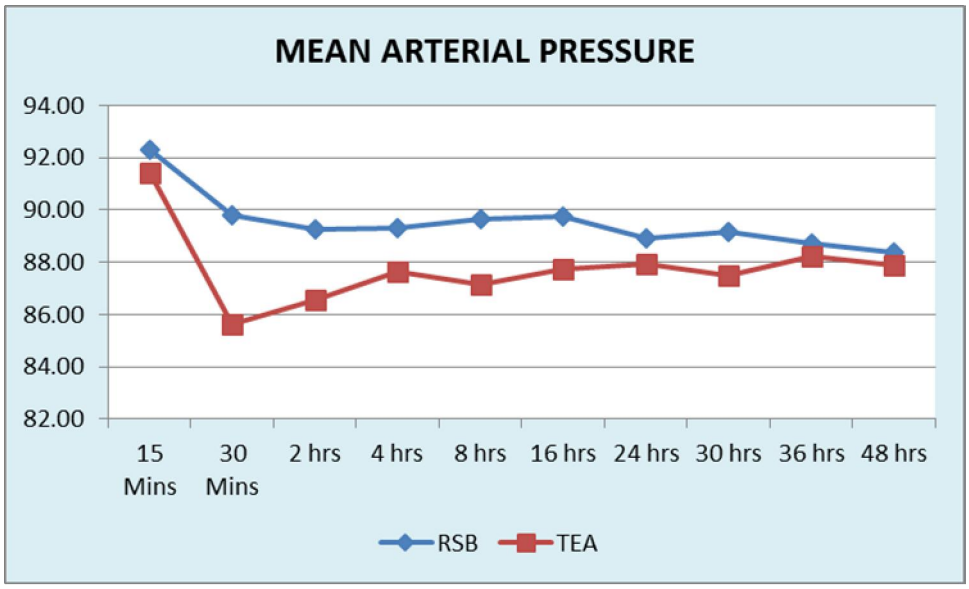

Figure 31: MEAN ARTERIAL PRESSURE

11) POST OPERATIVE NAUSEA :

Postoperative nausea and vomiting scores were measured over the 48hours. The scores were: No nausea = 0, mild nausea = 1, moderate nausea = 2, vomiting = 3. Rescue antiemetic was given if nausea score ≥ 2. Nausea score of 2 was in 13 patients in group RSB and vomiting was present in 3 patients. Nausea score of 2 was in 11 patients in Group TEA and 6 patients had vomiting . (Table 12, figure 32). P value was found to be not significant.

PONV SCORE	Group RSB	Group TEA	P value
0	18	22	0.477 Not Significant
1	16	11	
2	13	11	
3	3	6	

Table 12: POST OPERATIVE NAUSEA AND VOMITING

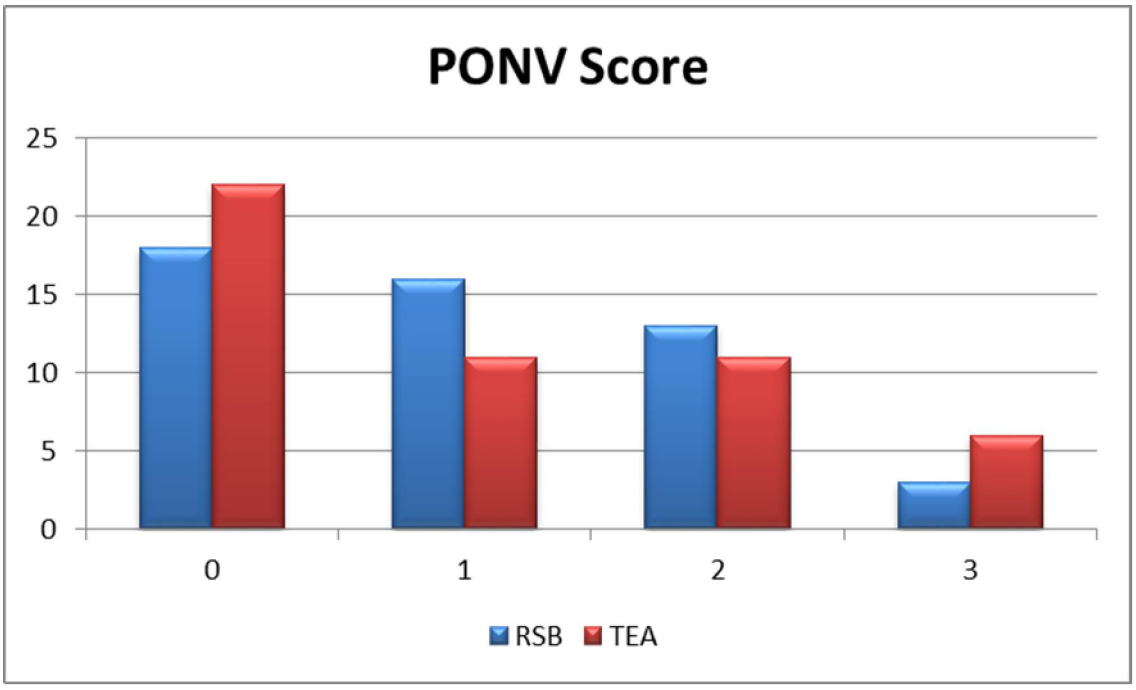

Figure 32: PONV SCORE

12) OVERALL PATIENT SATISFACTION

Postoperative satisfaction scores were poor = 1, fair = 2, Good = 3 and excellent = 4. In group RSB, 8 patients recorded score 1 and 22 patients scored 4. In Group TEA, 7 patients recorded scored 1 and 26 patients recorded score of 4 (Table 13, figure 33). P value was statistically insignificant.

	Group RSB	Group TEA	P value
1	8	7	0.875 Not significant
2	3	3	
3	17	14	
4	22	26	

Table 13: PATIENT SATISFACTION

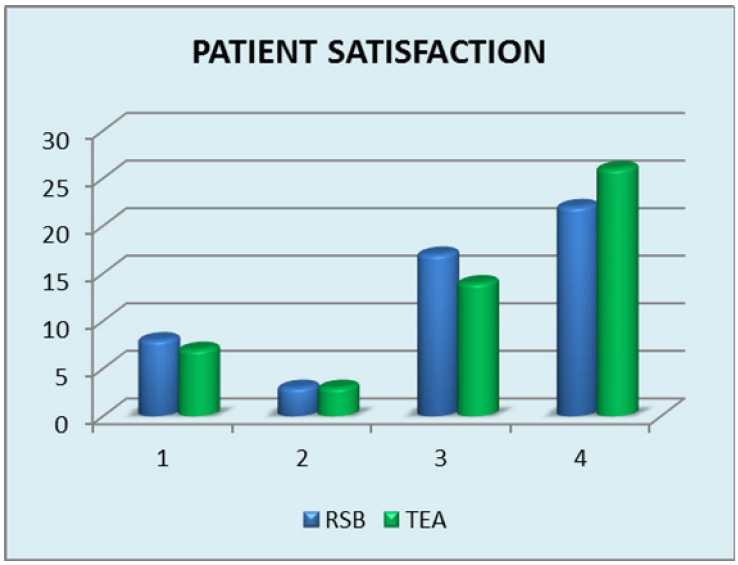

Figure 33: PATIENT SATISFACTION

13) FAILURE RATE

In group RSB patients, therapeutic failure rate was found in 8 out of 50 patients. In Group TEA therapeutic failure rate was found in 6 out of 50 patients. P value was found to be statistically insignificant. (Table 14, figure 34).

	GROUP RSB	GROUP TEA	P value
NO	42	44	0.564 Not Significant
YES	8	6	

Table 14: FAILURE RATE

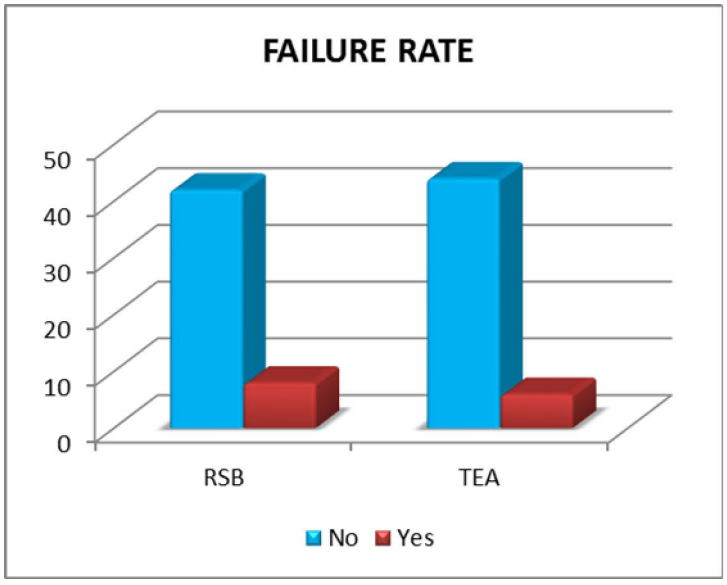

Figure 34: THERAPEUTIC FAILURE RATE

14) RESCUE ANALGESIC REQUIREMENT

Rescue analgesics were provided when Visual Analogue Score (VAS) scores ≥ 4, or on patient demand. Out of 50 patients in Group RSB, 13 of them required rescue analgesics, and in Group TEA also 11 patients required rescue analgesics. P value was found to be statistically insignificant. (Table 15, figure 35).

	GROUP RSB	GROUP TEA	P value
NO	37	39	0.640
YES	13	11	Not significant

Table 15: RESCUE ANALGESIC REQUIREMENT

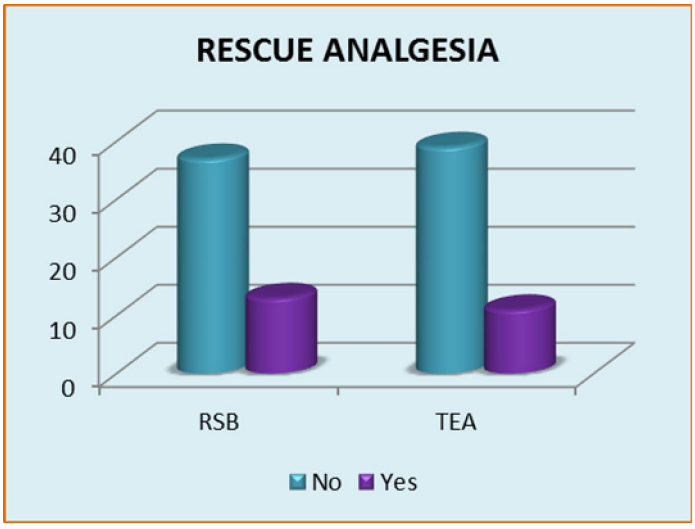

Figure 35: RESCUE ANALGESIC REQUIREMENT

15) HYPOTENSION

In Group RSB, there was no incidence of hypotension in all 50 patients. Whereas in Group TEA, there was significant hypotension in 10 out of 50 patients. The P value was 0.001, which is statistically significant (table 16, figure 36).

	Group RSB	Group TEA	P value
NO	**50**	**40**	0.001 Significant
YES	**0**	**10**	

Table 16: HYPOTENSION

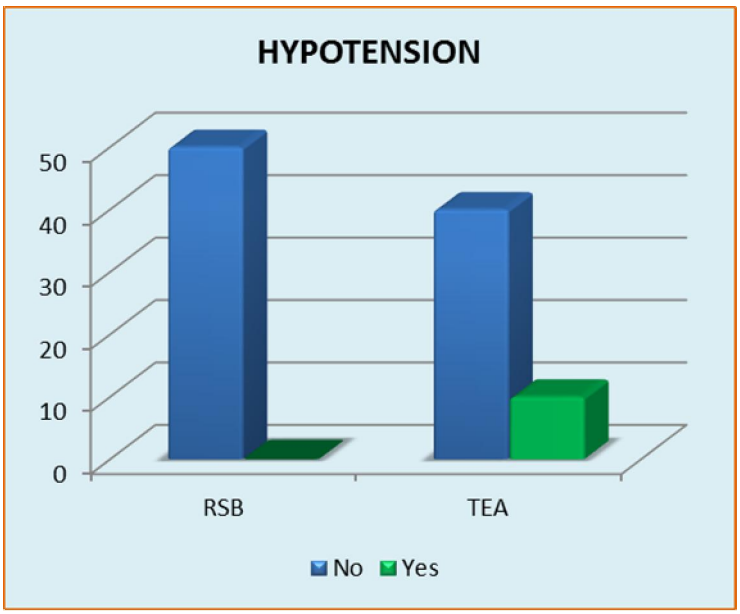

Figure 36: HYPOTENSION

16) BRADYCARDIA

No patient in either group had bradycardia at any point of time during the study (Table 17, fig 37).

	Group RSB	Group TEA
YES	0	0
NO	50	50

Table 17: BRADYCARDIA

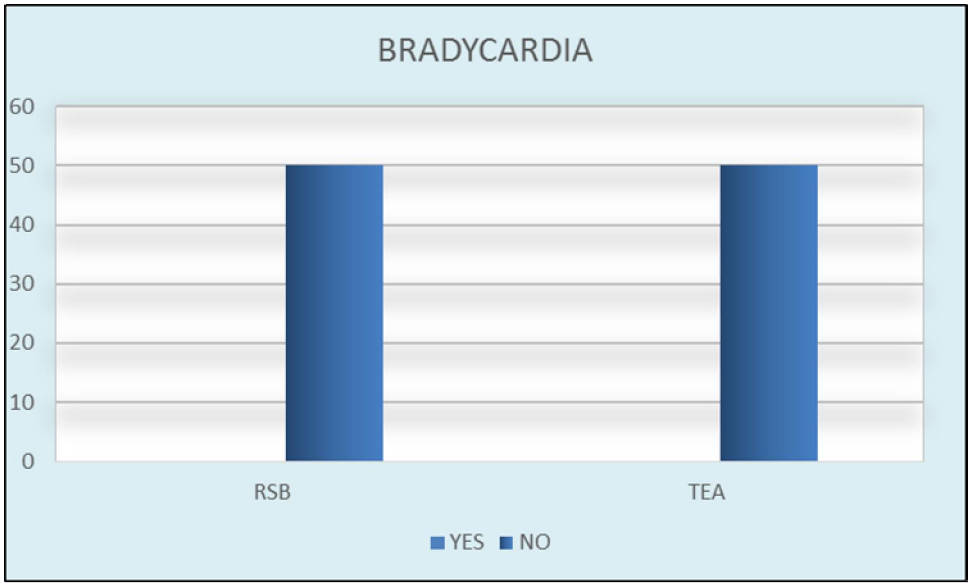

Figure 37: BRADYCARDIA

DISCUSSION

Midline laparotomy is performed commonly as elective or emergency surgery. Pain associated with these surgeries have considerable pain postoperatively which needs to be addressed. A good postoperative analgesic regimen is important to alleviate stress response in the postoperative period to improve the postoperative outcomes. Adequate postoperative analgesia facilitates earlier patient mobilisation and accelerates recovery.

Pain after laparotomy is more noticeable in the first two postoperative days. The pain is aggravated during mobilisation or coughing. Patients undergoing laparotomy are usually managed with intravenous opioids for postoperative analgesia. But systemic opioids provide analgesia when patient is at rest. Analgesia even on movement or coughing is provided essentially by regional anaesthesia techniques in the postoperative period. The gold standard technique that has been used for postoperative pain relief is epidural analgesia. With the advent of ultra-sonogram, truncal nerve blocks are gaining popularity. One of the most promising USG guided truncal nerve blocks used for postoperative pain relief in laparotomy is the rectus sheath block (RSB).

While there are various studies comparing epidural analgesia with conventional intravenous opioids and USG guided RSB with systemic opioids for post-operative pain relief, there are only very few studies comparing epidural analgesia with USG guided rectus sheath block.

We conducted this randomized prospective observer blinded clinical study to compare the analgesic efficacy of USG guided rectus sheath with thoracic epidural analgesia for post-operative pain relief in patients undergoing midline laparotomy surgery under general anaesthesia. In this study we planned to test the hypothesis that USG guided rectus sheath block would provide optimal post-operative analgesia that will be comparable to epidural analgesia.

So we conducted a study comparing the pain scores between rectus sheath block (RSB) group and thoracic epidural analgesia (TEA) group over a period of 48 hours. In addition post-operative nausea and vomiting (PONV), patient satisfaction at 48 hours, rescue analgesia with injection tramadol, complications associated with the procedure were evaluated between the 2 groups. The hemodynamic parameter over a period of 48 hours was also compared between RSB group and TEA group. Study was an observer blinded randomised clinical trial. Sample size selected was 100.

As far as the inclusion criteria was concerned, patients between the ages of 18-65 years were selected, since extremes of age will be a confounding variable. As far as ASA physical status concerned, ASA-PS, ASA-PS II and ASA-PS III patients were included in the study.

Patients who were excluded from the study were, patients with known hypersensitivity to local anaesthetics, patients with abnormal coagulation

status, pregnancy and patients with severe systemic illness Since Group TEA patients received epidural analgesia, patients with abnormal coagulation status and those with skin lesion at the site of blockade were excluded from the study.

Patients from both the groups were analysed for the demographic profile. Patients mean age and standard deviation were comparable between the RSB group and TEA group. Sex distribution were also comparable. The mean weight were similar between the two groups and the p-value computed using student t-test was insignificant. So the demographic profile as computed by student t-test and Chi-square test were similar between the RSB group and the TEA group.

In Group TEA the epidural catheter was placed before the induction of general anaesthesia. 16G Tuohy needle was used to identify epidural space with loss of resistance technique, using midline approach. In Group RSB the rectus sheath catheters were placed after the induction of general anaesthesia and before the surgical incision. USG guided rectus sheath block was performed using high frequency, linear array USG probe (6-12MHz). The Linear array probe was positioned transversely to identify the rectus muscle, then probe was moved laterally. Then using USG guidance a 16G Tuohy needle was inserted in an in-plane technique to locate the plane between the rectus muscle and the posterior rectus sheath.16G Tuohy needle was clearly distinct under real time USG. One factor which undoubtedly defines the

success rate of the block was clear visualisation of the needle tip at all time during the block.

Real time visualisation of the expansion of rectus sheath plane, was done by injecting via the Tuohy needle 4-5ml of normal saline. This is defined as the hydro-dissection of the plane between the posterior border of rectus muscle and posterior rectus sheath

Optimal needle location is indicated by the appearance of an “anechoic” fluid collection. Then the epidural catheter is inserted 4-6cm beyond the needle tip into the rectus plane**.** 20 ml of 0.25% Inj. bupivacaine via rectus sheath catheter was given and continued as intermittent bolus every 6 hours.

The local anaesthetic that was used in both the groups was bupivacaine. Bupivacaine is a commonly used drug both in epidural analgesia as well as USG guided rectus sheath block. In our study Bupivacaine was given as intermittent boluses in both RSB and TEA groups every 6 hours over a period of 48 hours postoperatively.

20 ml of injection 0.25 % bupivacaine was used in each rectus sheath catheters in RSB group patients and was repeated every 6 hours. 10 ml of injection 0.125% bupivacaine was used in TEA group and was repeated every 8 hours.

The primary outcome measure that was compared between the RSB group and TEA group, was the pain scores graded by visual analogue scores. The VAS scores were graded on a 0-10 cm scale. VAS scores were observed over a period of 48 hours in the postoperative period. VAS scores were observed at 15 minutes, 30 minutes, 2 hours, 4 hours, 8 hours, 16 hours, 24 hours, 30 hours, 36 hours and 48 hours.

The mean VAS scores at all the time intervals, measured were comparable between the RSB group and the TEA group. The p-value computed was statistically not significant. So the analgesic efficacy of USG guided RSB as measured by visual analogue pain scores were comparable with thoracic epidural analgesia.

One of the secondary outcome measures that were analysed was postoperative nausea and vomiting (PONV). Rescue anti-emetic, Inj. Ondensetron 4 mg intravenously was given when the PONV scores were ≥ 2. Average PONV scores were similar in both the groups. Incidence of vomiting would have been higher if an epidural narcotics were used as additive. However in our study 0.125% bupivacaine was alone used for epidural analgesia as intermittent boluses every 8 hours.

The next outcome measured was postoperative satisfaction score. A score of 4 which meant excellent postoperative satisfaction was recorded in 22 patients in Group RSB compared to 26 patients in group TEA. The mean postoperative satisfaction was slightly better in the Epidural group. This may be because of the vague underlying dull visceral pain in the RSB group.

Rescue analgesia was given as per the patient requirement and on patients demand. Rescue analgesia was given if VAS scores were greater than or equal to 4. Injection ondansetron 4 mg was given before administering Inj.Tramadol 100 mg. Rescue analgesia was required in 13 of the 60 patients in the RSB group and 11 of the 50 patients in the TEA group. So requirement of rescue analgesia was comparable in both the groups.

There was no incidence of bradycardia, respiratory depression, urinary retention in both the groups, but there was significant hypotension in the epidural group. 10 out of the 50 patients had hypotension that is defined as mean arterial pressure < 20% from baseline values. Episodes of hypotension were treated with fluid boluses of normal saline or ringer lactate. Patients who do not respond to crystalloids were to be given injection ephedrine. But all patients responded to fluid boluses. Physiological effect of sympathetic blockade was the reason behind this hypotension in TEA group. But there was no incidence of hypotension reported in the RSB group.

As far as the hemodynamic parameters are concerned there was a significant fall in systolic blood pressure and mean arterial pressure at periodic time intervals after activation of epidural catheter. So we concluded that USG guided TAP block was comparable to epidural analgesia in terms of post-operative pain relief. However in the epidural group incidence of hypotension was significant.

Adverse effects of epidural analgesia include unintentional dural puncture, transient neuropathy, spinal hematoma, CNS infections moreover

intrathecal or intravascular catheter migration can lead on to disastrous complications. Hypotension is present in epidural anaesthesia due to sympathetic blockade. Lower limb motor block is uncommon when using low concentrations of bupivacaine but when present can restrict early ambulation of the patient. Urinary retention is seen when sacral segments S2 to S4 are blocked by epidural analgesia.

Advantages of this USG guided RSB include optimal analgesia without the significant risk associated with neuraxial blocks especially when patients are on drugs which affect the coagulation such as aspirin, clopidogrel, heparin and others. Also in the setting of sepsis RSB can be judiciously used with minimal risk whereas epidural is contraindicated in such situations. Unlike in epidural, during insertion of the rectus sheath catheters, patient need not be accurately positioned and the procedure can be done after the induction of general anaesthesia which avoids the patients' discomfort. RSB has no significant haemodynamic effects which allows this technique to be used safely in patients presenting with hypotension either due to hypovolemia or sepsis in emergency situations.

Adding adjuvants to the local anaesthetic in RSB would further enhance the efficacy and duration of the block

CONCLUSION

The randomised controlled study conducted to compare the analgesic efficacy of Ultrasound guided rectus sheath block with thoracic epidural analgesia for postoperative pain relief in midline laparotomy surgeries concluded that ultrasound guided RSB is comparable to epidural analgesia. USG guided RSB can be an effective alternative and is easier to learn and less invasive technique compared to epidural analgesia, USG guided RSB would play an important part of the postoperative analgesia regimen, devoid of the side effects of epidural anaesthesia.

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INSTITUTIONAL ETHICAL COMMITTEE, STANLEY MEDICAL COLLEGE, CHENNAI-1

Title of the Work : A Randomised controlled study comparing the analgesic efficacy of Thoracic Epidural analgesia versus ultrasound guided rectus sheath block for midline laparotomy surgery .

Principal Investigator : Dr. Arul.J

Designation : PG MD (Anesthesiology)

Department : Department of Anesthesiology
Government Stanley Medical College,
Chennai-01

The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 25.03.2015 at the Council Hall, Stanley Medical College, Chennai-1 at 2PM

The members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

The Principal investigator and their team are directed to adhere to the guidelines given below:

1. You should inform the IEC in case of changes in study procedure, site investigator investigation or guide or any other changes.
2. You should not deviate from the area of the work for which you applied for ethical clearance.
3. You should inform the IEC immediately, in case of any adverse events or serious adverse reaction.
4. You should abide to the rules and regulation of the institution(s).
5. You should complete the work within the specified period and if any extension of time is required, you should apply for permission again and do the work.
6. You should submit the summary of the work to the ethical committee on completion of the work.

MEMBER SECRETARY,
IEC, SMC, CHENNAI

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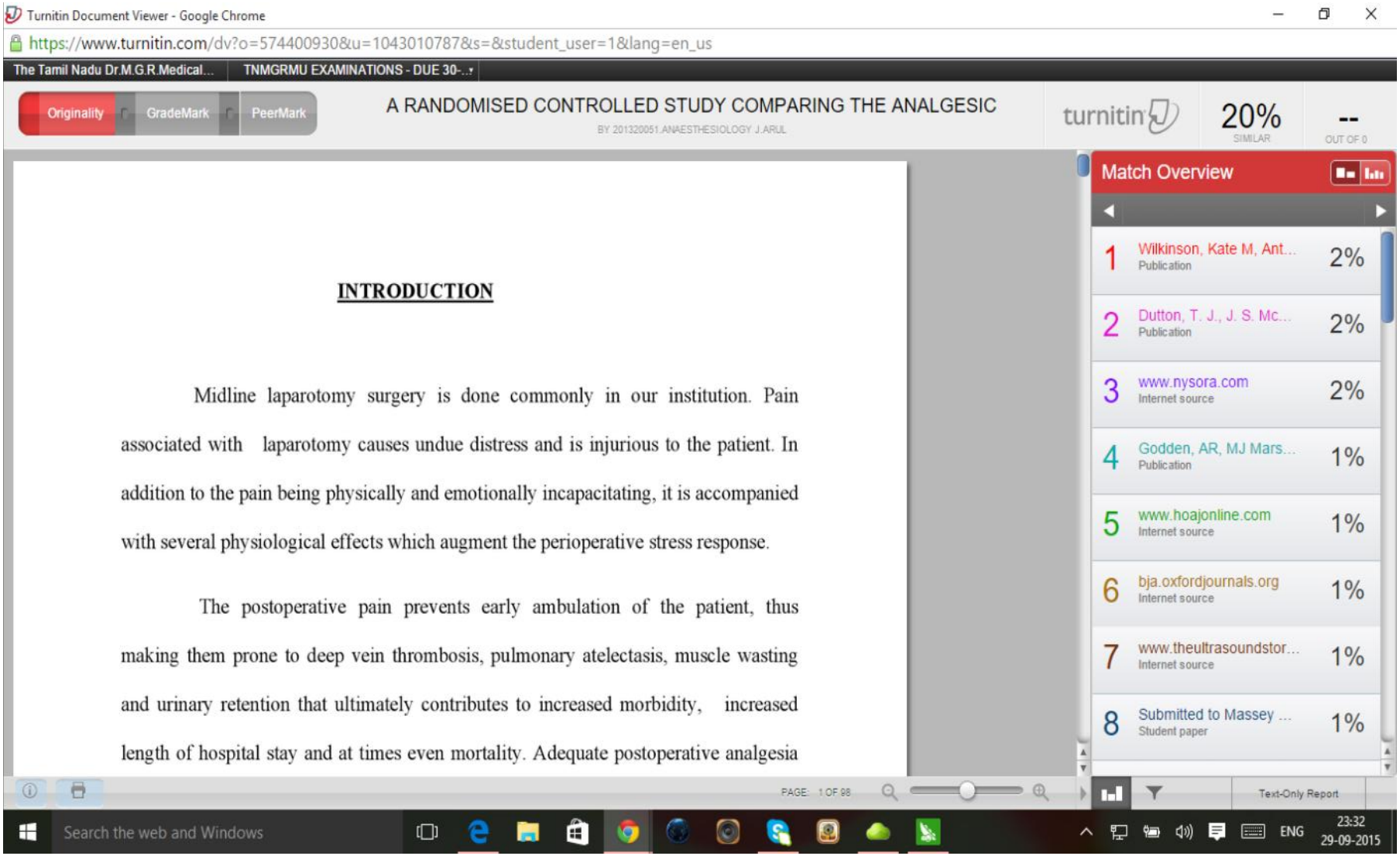
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INTRODUCTION
Midline laparotomy surgery is done commonly in our institution. Pain associated with laparotomy causes undue distress and is injurious to the patient. In addition to the pain being physically and emotionally incapacitating, it is accompanied with several physiological effects which augment the perioperative stress response.
The postoperative pain prevents early ambulation of the patient, thus making them prone to deep vein thrombosis, pulmonary atelectasis, muscle wasting and urinary retention that ultimately contributes to increased morbidity, increased length of hospital stay and at times even mortality. Adequate postoperative analgesia
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நோயாளியின் தகவல் தாள்

வயிற்றுப்பகுதியில் அறுவை சிகிச்சை (Laparotomy) செய்யும்போது, அறுவை சிகிச்சைக்குபின் வலியை குறைக்க பயன்படும் அல்ட்ரா சோனோகிராம் உதவி மூலம் ரெக்டஸ் ஷீத் பிளாக் (Rectus Sheath Block) மற்றும் எப்பிடியூரல் (Epidural Analgesia) மயக்க மருந்து முறை பற்றி ஒரு ஒப்பீட்டு ஆய்வு

ஆராய்ச்சியின் நோக்கம் என்ன?

இந்த ஆய்வின் நோக்கம் வயிற்று பகுதி அறுவை சிகிச்சைக்கு (லேப்ராட்டமி) பிறகு வலி குறைக்க எபிடியூரல் மயக்க முறை / அல்ட்ரா சோனோகிராம் உதவியுடன் வயிற்று பகுதியில் ரெக்டஸ் ஷீத் பிளாக் முறையில் எது சிறந்தது என்பதை கண்டுபிடித்தல் பற்றிய ஆய்வு.

இந்த மருத்துவ சோதனை முறையில் யார் பங்கேற்க முடியும்

வயிற்றுப்பகுதி அறுவைசிகிச்சைக்கு (லேப்ராட்டமி) திட்டமிடப்பட்டுள்ள நோயாளிகள் வயது 18 முதல் 60 ஆண்டுகள், (ASA I/II/III வகையில் உள்ளடக்கப்படுபவர்கள்)

இந்த ஆய்வில் யார் பங்கேற்கக் கூடாது?

இரத்தம் வடிதல் சீர்கேடுகள், ஊசி செலுத்தும் தளத்தில் தோல் நோய், மயக்க மருந்து ஓவ்வாமை, டிரான்ஸ்வர்ஸ் பிளவு அறுவை சிகிச்சை முறை மற்றும் இந்த முறைக்கு விருப்பமில்லாதவர்கள் இந்த ஆய்வில் பங்கேற்கக் கூடாது.

இந்த மருத்துவ சோதனையின் நடைமுறை என்ன?

நோயாளிகளுக்கு இரண்டு முறைகளில் ஒன்று ஒதுக்கீடு செய்தல், ஒரு குழுமத்திற்கு முதுகெலும்பின் நடுபகுதியில் எப்பிடியூரல் கத்தீட்டர் மூலம் மருந்து செலுத்துதல், மற்றொரு குழுமத்திற்கு வயிற்றுப்பகுதியின் ரெக்டஸ் தசைக்கு அடியில் கத்தீட்டர் மூலம் மருந்து செலுத்துதல்.

இந்த செய்முறையின் நன்மைகள் என்ன?

அறுவை சிகிச்சைக்கு பின் குறைந்த வலியிருக்கும் நோயாளிகள் அறுவை சிகிச்சைக்கு பின் நடமாடலாம்.

இந்த செயல்முறையின் பின்விளைவுகள் என்ன?

இந்த செயல்முறையால் பயன்படுத்தப்படும் மருந்து முறையில் தலைவலி, இதய துடிப்பு மற்றும் இரத்த அழுத்தம் குறைதல் வாய்ப்புகள் உண்டு.

இந்த மருத்துவ சோதனையின் சேருவது கட்டாயமா?

இல்லை, இந்த மருத்துவச் சோதனையில் சேருவது உங்கள் விருப்பம் நீங்கள் எந்த நேரத்திலும் இந்த மருத்துவச் சோதனையை விட்டு செல்லமுடியும்.

என்னை பற்றிய தகவல்கள் ரகசியமாக இருக்குமா?

ஆம் உங்கள் பெயர் பற்றிய தகவல்கள் உங்கள் தனிப்பட்ட விவரங்கள் ரகசியமாக இருக்கும்.

நோயாளியின் கையொப்பம்

(இடது பெருவிரல் ரேகை)

தேதி

மருத்துவரால் தெளிவாக

படித்துக் காட்டப்பட்டது.

சுய ஒப்புதல் படிவம்

வயிற்றுப்பகுதியில் அறுவை சிகிச்சை (Laparotomy) செய்யும்போது, அறுவை சிகிச்சைக்குபின் வலியை குறைக்க பயன்படும் அல்ட்ரா சோனோகிராம் உதவி மூலம் ரெக்டஸ் ஷீத் பிளாக் (Rectus Sheath Block) மற்றும் எப்பிடியூரல் (Epidural Analgesia) மயக்க மருந்து முறை பற்றி ஒரு ஒப்பீட்டு ஆய்வு

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ஸ்டான்லி மருத்துவ கல்லூரி - சென்னை

பெயர் : வயது : உள்ளிருப்பு எண் :

இந்த மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது என்னுடைய சந்தேகங்களை தீர்க்கவும் அதற்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டது.

நான் இவ்வாய்வில் தன்னிச்சையாகத் தான் பங்கேற்கிறேன். எந்த காரணத்தினாலும் எந்த கட்டத்திலும் எந்த சட்டசிக்கலும் இன்றி இந்த ஆய்விலிருந்து விலகிக் கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.

நான் ஆய்விலிருந்து விலகிக் கொண்டாலும் ஆய்வாளர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கோ அல்லது உபயோகிக்கவோ என் அனுமதி தேவையில்லை எனவும் அறிந்து கொண்டேன். என்னை பற்றிய தகவல்கள் ரகசியமாக பாதுகாக்கப்படும் என்பதையும் அறிவேன்.

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும் பரிசோதனை முடிவுகளையும் ஆய்வாளர் அவர் விருப்பத்திற்கேற்ப பயன்படுத்திக் கொள்ளவும் அதனை பிரசுரிக்கவும் முழுமனதுடன் சம்மதிக்கிறேன்.

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன் எனக்கு கொடுக்கப்பட்டுள்ள அறிவுரைகளின்படி நடந்து கொள்வதுடன் ஆய்வாளருக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதி அளிக்கிறேன்.

உடல்நலம் பாதிக்கப்பட்டாலோ வழக்கத்திற்கு மாறான ஏதேனும் நோய்குறி தென்பட்டாலோ அதனை தெரிவிப்பேன் என்றும் உறுதி கூறுகிறேன்.

இந்த ஆய்வில் எனக்கு எவ்விதமான பரிசோதனைகளையும் சிகிச்சைகளையும் மேற்கொள்ள நான் முழுமனதுடன் சம்மதிக்கிறேன்.

நாள் :

இப்படிக்கு

ஆய்வாளரின் கையொப்பம் நோயாளியின் கையொப்பம்

PROFORMA

Name: Wt:

Age/sex: Male/Female

Date:

IP No: ASA:

Diagnosis: COMORBID CONDITIONS:

Procedure:

Group Allocated: RSB/TEA

Time of start of surgery:

Epidural Level

STANDARD GENERAL ANAESTHESIA

Premedication	Inj.glycopyrrolate Inj.midazolam
Preoxygenation	100% O2 for 3 min @6L/min
Induction	Inj.fentanyl Inj.propofol Inj.vecuronium
Intubation	
Maintenance	N20:O2
Volatile agent	

Reversal: Inj. Neostigmine
Inj.glycopyrrolate

EXTUBATED: YES/NO TIME:

TOTAL DURATION OF SURGERY:

POST OPERATIVE MONITORING

INTERMITTENT BOLUS (6 hourly) INJ.BUPIVACAINE

	1	2	3	4	5	6	7	8
RSB(0.25% --20ml in each catheter)								
TEA 0.125%---10ml								

POSTOP MONITORING

TIME	VAS	PR	BP	MAP	SPO2
15 min					
30 min					
2 hr					
4 hr					
8 hr					
16 hr					
24 hr					
30 hr					
36 hr					
48 hr					

SECONDARY OUTCOMES

PONV	0	1	2	3	
RESCUE ANALGESIA	YES	NO			
PATIENT SATISFACTION	1 poor	2 fair	3 good	4 excellent	
TECHNICAL/THERAPEUTIC FAILURE	YES	NO			

COMPLICATIONS

HYPOTENSION	YES	NO
BRADYCARDIA	YES	NO
RESP.DEPRESSION	YES	NO
OTHERS (If any)		

MASTER CHART

DATE	S. NO	GROUP	NAME	AGE	SEX	WEIGHT	IP NO	DURATION	DIAGNOSIS	PROCEDURE
04-05-15	1	RSB	ASHOKAN	44	M	64	1532119	140	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
06-05-15	2	RSB	SUNDARAMOORTHY	52	M	75	1532176	125	CA STOMACH	LAPAROTOMY
08-05-15	3	TEA	FAILABATH	48	F	66	1532342	130	OBSTRUCTED INCISIONAL HERNIA	LAPAROTOMY
08-05-15	4	TEA	THILAGAVATHY	38	F	56	1536431	160	INCISIONAL HERNIA	MESH REPAIR
09-05-15	5	RSB	MUTHIAYAN	35	M	82	1534287	120	POST ILEOSTOMY STATUS	ILEOSTOMY CLOSURE
10-05-15	6	TEA	VISHWANATHAN	44	M	72	1533274	100	APPENDICULAR PERFORATION	LAPAROTOMY
11-05-15	7	RSB	MUTHU	53	M	66	1533795	135	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
13-05-15	8	RSB	KANNIAPPAN	49	M	60	1533532	128	CA STOMACH	LAPAROTOMY
15-05-15	9	RSB	SHANMUGAM	30	M	78	1533268	185	UMBILICAL HERNIA	MESH REPAIR
15-05-15	10	TEA	SIVAKUMAR	46	M	87	1533843	125	OBSTRUCTED INCISIONAL HERNIA	ANATOMICAL REPAIR
17-05-15	11	RSB	NIRMALA	58	F	64	1533921	145	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
17-05-15	12	RSB	GOPAL	55	M	77	1533970	138	CA STOMACH	LAPAROTOMY
18-05-15	13	TEA	SUNDARAM	54	M	75	1533654	120	INCISIONAL HERNIA	MESH REPAIR
20-05-15	14	TEA	RAJAKUMAR	38	M	64	1534012	125	APPENDICULAR PERFORATION	LAPAROTOMY
23-05-15	15	RSB	GANESAN	60	M	88	1533874	150	APPENDICULAR PERFORATION	LAPAROTOMY
24-05-15	16	TEA	DHANASEKAR	45	M	86	1533901	125	L OVARIAN CYST	LAPAROTOMY
24-05-15	17	TEA	DEVI	39	F	78	1534276	140	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
29-05-15	18	RSB	SAMPATH	48	M	78	1534326	120	INTESTINAL OBSTRUCTION	LAPAROTOMY
29-05-15	19	RSB	MURUGAN	49	M	76	1534322	125	DU PERFORATION	LAPAROTOMY
31-05-15	20	TEA	SRINIVASAN	42	M	56	1534375	160	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
01-06-15	21	TEA	PERUMAL	38	M	82	1534432	120	APPENDICULAR PERFORATION	LAPAROTOMY
02-06-15	22	RSB	MOHAMMED ALI	51	M	77	1534197	115	CA STOMACH	LAPAROTOMY
02-06-15	23	RSB	MANIKARAJ	48	M	75	1534498	120	APPENDICULAR PERFORATION	LAPAROTOMY
02-06-15	24	TEA	PRABHU	29	M	86	1534742	135	CA HEAD OF PANCREAS	TRIPLE BYPASS
04-06-15	25	TEA	VENKATESAN	57	M	78	1534532	165	OBSTRUCTED INCISIONAL HERNIA	LAPAROTOMY
05-06-15	26	TEA	MURUGAN	43	M	86	1534254	150	INCISIONAL HERNIA	MESH REPAIR
07-06-15	27	RSB	MARIAMMAL	40	F	58	1535434	120	POST LAP.CHOLECYSTECTOMY STATUS	LAPAROTOMY
04-07-15	28	TEA	KARTHI	24	M	78	1537653	130	OBSTRUCTED INCISIONAL HERNIA	LAPAROTOMY
08-07-15	29	RSB	DHANUSH	36	M	64	1538690	140	INTESTINAL OBSTRUCTION	LAPAROTOMY
08-07-15	30	RSB	VASANTHA	50	F	87	1538551	135	INTESTINAL OBSTRUCTION	LAPAROTOMY

DATE	S. NO	GROUP	NAME	AGE	SEX	WEIGHT	IP NO	DURATION	DIAGNOSIS	PROCEDURE
08-07-15	31	TEA	IRUDHAYASAMY	50	M	65	1539207	122	HOLLOW VISCOUS PERFORATION	LAPAROTOMY
08-07-15	32	RSB	ASHOK	44	M	75	1536375	180	HEPATIC FLEXURE GROWTH	R HEMICOLECTOMY
08-07-15	33	RSB	RAMESH	49	M	66	1536506	125	LOOP ILEOSTOMY	ILEOSTOMY TAKE DOWN
08-07-15	34	TEA	BHASKAR	38	M	75	1536595	130	LOOP ILEOSTOMY	ILEOSTOMY TAKE DOWN
09-07-15	35	RSB	MOHAN	43	M	76	1525983	190	CHOLELITHIASIS WITH CHOLEDOCOLITHIASIS	CHOLECYSTECTOMY
10-07-15	36	TEA	SUDHA	43	F	87	1531930	190	CA ASCENDING COLON	R HEMICOLECTOMY
13-07-15	37	TEA	RAJA	50	M	66	1539562	145	SMALL BOWEL PERFORATION	LAPAROTOMY
14-07-15	38	RSB	BABU	45	M	56	1535586	115	LOOP COLOSTOMY STATUS	COLOSTOMY CLOSURE
14-07-15	39	RSB	PONVEL	42	M	64	1536254	180	PSEUDOCYST OF PANCREAS	CYSTOGASROSTOMY
15-07-15	40	TEA	PUSHPA	29	F	55	1538935	105	UMBILICAL HERNIA	ANATOMICAL REPAIR
15-07-15	41	TEA	PUNITHA	35	F	58	1539811	125	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
15-07-15	42	RSB	ANNAMALAI	56	M	76	1539823	150	DU PERFORATION	LAPAROTOMY
17-07-15	43	RSB	NEELAKANDAN	60	M	65	1540446	165	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
20-07-15	44	TEA	VARADHARAJAN	65	M	66	1540535	180	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
21-07-15	45	RSB	RAMESH	37	M	75	1538402	190	CA STOMACH	LAPAROTOMY
29-07-15	46	RSB	RAJESHWARI	51	F	58	1537348	260	PERIAMPULLARY CA	WHIPPLES PROCEDURE
01-08-15	47	TEA	MALLIGA	50	F	66	1538743	185	CA R OVARY	TAH
04-08-15	48	TEA	SUBBURAYAN	47	M	66	1538888	245	RETROPERITONEAL SARCOMA	LAPAROTOMY
04-08-15	49	RSB	RAVICHANDRAN	57	M	76	1541792	155	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
11-08-15	50	TEA	RAJENDRAN	56	M	76	1543692	165	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
14-08-2015	51	RSB	DHANUSHAN	62	M	75	1538690	195	CA DESCENDING COLON	L HEMICOLECTOMY
14-08-2015	52	TEA	YUVARAJ	44	M	86	1539287	120	APPENDICULAR PERFORATION	LAPAROTOMY
15-08-2015	53	RSB	SATHISH	37	M	76	1540128	145	INCISIONAL HERNIA	MESH REPAIR
17-08-2015	54	TEA	PADMAVATHY	49	F	77	1540234	115	UMBILICAL HERNIA	ANATOMICAL REPAIR
18-08-2015	55	TEA	MUTHUKRISHNAN	55	M	75	1540225	120	INCISIONAL HERNIA	MESH REPAIR
18-08-2015	56	TEA	SRINIVASAN	58	M	78	1540119	135	INTESTINAL OBSTRUCTION	LAPAROTOMY
19-08-2015	57	RSB	RAFIQ	44	M	86	1540365	120	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
22-08-2015	58	TEA	MURUGESAN	58	M	90	1540748	100	CA STOMACH	LAPAROTOMY
22-08-2015	59	TEA	KRISHNAN	47	M	76	1540634	125	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
23-08-2015	60	TEA	RAJESH	47	M	74	1540923	130	UMBILICAL HERNIA	ANATOMICAL REPAIR
23-08-2015	61	RSB	THANGAM	53	F	73	1540819	180	APPENDICULAR ABCESS	LAPAROTOMY
23-08-2015	62	TEA	LAKSHMIPATHY	48	M	75	1540229	125	HOLLOW VISCOUS PERFORATION	LAPAROTOMY
24-08-2015	63	RSB	RAMANUJAM	42	M	86	1540912	130	INCISIONAL HERNIA	LAPAROTOMY
25-08-2015	64	RSB	AMARDAS	44	M	69	1541003	150	OBSTRUCTED INCISIONAL HERNIA	MESH REPAIR
25-08-2015	65	RSB	NAGAPPAN	51	M	63	1540843	135	UMBILICAL HERNIA	MESH REPAIR
26-08-2015	66	TEA	SINGAN	60	M	75	1540834	120	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY

DATE	S. NO	GROUP	NAME	AGE	SEX	WEIGHT	IP NO	DURATION	DIAGNOSIS	PROCEDURE
27-08-2015	67	TEA	DHARMALINGAM	54	M	85	1540913	160	UMBILICAL HERNIA	MESH REPAIR
28-08-2015	68	RSB	ANANDHI	38	F	78	1540919	145	APPENDICULAR PERFORATION	LAPAROTOMY
28-08-2015	69	RSB	GANESAN	51	M	56	1541237	120	POST ILEOSTOMY STATUS	ILEOSTOMY CLOSURE
28-08-2015	70	TEA	GOPI	55	M	69	1541288	120	UMBILICAL HERNIA	MESH REPAIR
30-08-2015	71	TEA	PARVATHY	40	F	75	1540975	118	CA STOMACH	LAPAROTOMY
30-08-2015	72	RSB	KESAVAN	48	M	78	1540899	145	INCISIONAL HERNIA	MESH REPAIR
31-08-2015	73	RSB	SAMPATH	55	M	59	1541020	185	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
31-08-2015	74	TEA	KARTHIGA	29	F	78	1541176	125	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
31-08-2015	75	RSB	JANAKIRAMAN	52	M	77	1541213	140	UMBILICAL HERNIA	MESH REPAIR
01-09-2015	76	TEA	KARUNAKARAN	57	M	74	1541294	130	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
01-09-2015	77	RSB	VENKATESAN	42	M	82	1541229	120	CA STOMACH	LAPAROTOMY
01-09-2015	78	RSB	GNANAVEL	49	M	90	1542034	115	UMBILICAL HERNIA	MESH REPAIR
02-09-2015	79	RSB	SOMASUNDARAM	59	M	59	1541789	155	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
02-09-2015	80	TEA	CHIDAMBARAM	55	M	75	1541984	140	APPENDICULAR PERFORATION	LAPAROTOMY
03-09-2015	81	TEA	KESAVAN	40	M	77	1541993	130	LIVER ABCESS	LAPAROTOMY
04-09-2015	82	TEA	PUSHPARAJ	48	M	76	1542164	145	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
04-09-2015	83	RSB	RAJAMMAL	55	F	68	1542266	120	UMBILICAL HERNIA	MESH REPAIR
04-09-2015	84	TEA	VASANTHAKUMAR	58	M	68	1541843	120	APPENDICULAR ABCESS	LAPAROTOMY
05-09-2015	85	RSB	SIMSON	38	M	78	1541854	130	UMBILICAL HERNIA	MESH REPAIR
05-09-2015	86	TEA	PARTHASARATHY	40	M	66	1541972	145	INTESTINAL OBSTRUCTION	LAPAROTOMY
05-09-2015	87	RSB	SENTHIL	48	M	87	1542167	160	SUBACUTE INTESTINAL OBSTUCTION	LAPAROTOMY
06-09-2015	88	RSB	RAJADURAI	52	M	81	1542286	135	PARA UMBILICAL HERNIA	MESH REPAIR
06-09-2015	89	TEA	SUGANTHI	49	F	88	1542212	130	INCISIONAL HERNIA	MESH REPAIR
06-09-2015	90	RSB	MANIKANDAN	53	M	73	1542200	120	APPENDICULAR PERFORATION	LAPAROTOMY
07-09-2015	91	TEA	THULASI	55	F	74	1542198	120	OBSTRUCTED INCISIONAL HERNIA	LAPAROTOMY
07-09-2015	92	TEA	BALAKRISHNAN	40	M	68	1542197	110	CA STOMACH	LAPAROTOMY
08-09-2015	93	RSB	VIJAYAN	44	M	68	1544276	125	BLUNT INJURY ABDOMEN	LAPAROTOMY
08-09-2015	94	RSB	KASTHURI	57	F	73	1544154	140	INCISIONAL HERNIA	MESH REPAIR
08-09-2015	95	TEA	CHOKKAMMA	50	F	64	1543298	135	INCISIONAL HERNIA	MESH REPAIR
09-09-2015	96	RSB	JAYACHANDRAN	47	M	84	1543207	115	APPENDICULAR PERFORATION	LAPAROTOMY
10-09-2015	97	TEA	MANI	59	M	77	1544265	120	INTESTINAL OBSTRUCTION	LAPAROTOMY
10-09-2015	98	TEA	MOHAN	54	M	75	1544209	135	UMBILICAL HERNIA	MESH REPAIR
10-09-2015	99	RSB	PERIYASAMY	50	M	85	1544215	150	CHOLEDOCHOLITHIASIS	CBD EXPLORATION
10-09-2015	100	TEA	KUPPAN	56	M	80	1544302	185	CA STOMACH	LAPAROTOMY

S.NO	Group	PS	VAS										PONV Score	Patient satisfac - tion	TechnicaL Failure	Rescue Analgesia	Brady - cardia	Hypo- Tension	Respiratory Depression
			15	30	2	4	8	16	24	30	36	48							
1	RSB	2	2	2	3	3	2	2	3	2	2	1	3	4	NO	NO	NO	NO	NIL
2	RSB	3	2	2	2	3	3	2	2	2	2	1	3	4	NO	NO	NO	NO	NIL
3	TEA	2	3	4	4	3	3	3	4	2	2	2	1	2	NO	YES	NO	NO	NIL
4	TEA	1	3	2	2	3	3	2	2	2	3	2	1	3	NO	NO	NO	YES	NIL
5	RSB	2	2	2	3	2	3	3	2	2	3	1	0	4	NO	NO	NO	NO	NIL
6	TEA	2	2	3	3	2	2	2	2	2	2	2	0	4	NO	NO	NO	NO	NIL
7	RSB	1	3	2	2	3	2	2	2	2	2	2	0	4	NO	NO	NO	NO	NIL
8	RSB	3	7	6	5	5	7	7	5	4	4	4	2	1	YES	YES	NO	NO	NIL
9	RSB	1	2	2	3	2	3	3	2	2	3	1	0	3	NO	NO	NO	NO	NIL
10	TEA	2	3	4	6	4	4	3	3	2	2	2	3	2	YES	YES	NO	NO	NIL
11	RSB	1	2	2	2	2	2	3	2	1	2	2	1	4	NO	NO	NO	NO	NIL
12	RSB	3	3	3	3	1	3	3	2	2	3	1	0	4	NO	NO	NO	NO	NIL
13	TEA	2	2	2	1	3	2	2	2	1	3	2	0	4	NO	NO	NO	NO	NIL
14	TEA	2	2	2	2	1	2	2	2	2	2	2	2	3	NO	NO	NO	YES	NIL
15	RSB	2	2	2	2	2	2	3	2	2	2	2	0	4	NO	NO	NO	NO	NIL
16	TEA	3	3	3	3	3	3	3	3	3	2	1	0	4	NO	NO	NO	NO	NIL
17	TEA	3	2	2	2	2	2	3	2	1	3	3	1	3	NO	NO	NO	YES	NIL
18	RSB	1	4	8	6	4	4	7	7	5	4	3	3	1	YES	YES	NO	NO	NIL
19	RSB	2	2	2	2	1	2	2	2	2	2	2	2	3	NO	NO	NO	NO	NIL
20	TEA	2	2	1	3	3	3	3	2	2	3	1	1	4	NO	NO	NO	NO	NIL
21	TEA	1	3	3	1	2	3	2	1	1	2	3	1	3	NO	NO	NO	NO	NIL
22	RSB	2	2	3	3	3	2	3	2	2	3	3	1	3	NO	NO	NO	NO	NIL
23	RSB	1	2	1	3	3	3	3	2	2	3	1	0	3	NO	NO	NO	NO	NIL
24	TEA	2	3	1	2	1	2	3	2	2	3	2	1	4	NO	NO	NO	NO	NIL
25	TEA	2	3	3	1	2	3	2	1	1	2	3	2	4	NO	NO	NO	NO	NIL
26	TEA	1	3	1	2	1	2	3	2	2	3	2	0	3	NO	NO	NO	NO	NIL
27	RSB	1	3	2	3	3	2	2	2	3	3	2	2	3	NO	NO	NO	NO	NIL
28	TEA	2	2	2	1	2	3	2	1	1	3	1	0	4	NO	NO	NO	NO	NIL

S.NO	Group	PS	VAS										PONV Score	Patient satisfac - tion	TechnicaL Failure	Rescue Analgesia	Brady - cardia	Hypo- Tension	Respiratory Depression
			15	30	2	4	8	16	24	30	36	48							
29	RSB	2	3	3	3	5	5	4	4	2	2	2	0	2	NO	YES	NO	NO	NIL
30	RSB	2	5	7	5	6	4	4	7	4	3	3	2	1	YES	YES	NO	NO	NIL
31	TEA	3	2	2	1	2	3	2	1	1	3	1	0	4	NO	NO	NO	NO	NIL
32	RSB	3	2	3	3	3	3	3	2	2	3	3	1	4	NO	NO	NO	NO	NIL
33	RSB	2	3	3	3	3	2	2	3	2	2	2	2	3	NO	NO	NO	NO	NIL
34	TEA	2	2	3	3	3	3	3	2	2	3	3	0	3	NO	NO	NO	YES	NIL
35	RSB	2	2	3	3	3	2	3	2	2	3	3	1	3	NO	NO	NO	NO	NIL
36	TEA	3	2	3	3	3	3	3	2	2	3	3	0	4	NO	NO	NO	NO	NIL
37	TEA	3	3	3	3	3	3	3	3	2	2	2	1	3	NO	NO	NO	NO	NIL
38	RSB	2	6	8	5	4	7	3	3	3	3	3	2	1	YES	YES	NO	NO	NIL
39	RSB	2	2	2	1	2	3	2	1	1	3	1	0	4	NO	NO	NO	NO	NIL
40	TEA	1	2	3	3	3	2	3	2	2	3	3	0	4	NO	NO	NO	NO	NIL
41	TEA	1	8	8	5	4	4	5	5	4	4	4	0	1	YES	YES	NO	YES	NIL
42	RSB	3	2	2	1	2	3	2	1	1	3	1	0	3	NO	NO	NO	NO	NIL
43	RSB	1	2	3	3	3	2	3	2	2	3	3	1	3	NO	NO	NO	NO	NIL
44	TEA	2	5	8	5	7	4	6	4	4	3	3	3	1	YES	YES	NO	NO	NIL
45	RSB	3	2	3	3	3	2	3	2	2	3	3	2	4	NO	NO	NO	NO	NIL
46	RSB	3	3	4	5	4	4	3	3	2	2	2	0	2	NO	YES	NO	NO	NIL
47	TEA	3	2	3	3	3	2	3	2	2	3	3	3	3	NO	NO	NO	NO	NIL
48	TEA	3	3	4	5	4	4	3	3	2	2	2	0	1	NO	YES	NO	NO	NIL
49	RSB	2	2	2	1	2	3	2	1	1	3	1	2	4	NO	NO	NO	NO	NIL
50	TEA	2	2	2	1	2	3	2	1	1	3	1	2	4	NO	NO	NO	NO	NIL
51	RSB	3	2	2	2	3	2	2	2	2	2	1	1	4	NO	NO	NO	NO	NIL
52	TEA	2	2	2	2	3	2	2	2	2	2	1	0	3	NO	NO	NO	NO	NIL
53	RSB	3	5	3	4	2	3	2	2	2	2	2	1	2	NO	YES	NO	NO	NIL
54	TEA	2	3	2	2	3	2	2	2	2	2	2	1	3	NO	NO	NO	NO	NIL
55	TEA	2	2	2	3	2	3	3	2	2	3	1	1	4	NO	NO	NO	NO	NIL
56	TEA	2	2	3	3	2	2	2	2	2	2	2	3	4	NO	NO	NO	NO	NIL
57	RSB	2	3	2	2	3	2	2	2	2	2	2	2	3	NO	NO	NO	NO	NIL
58	TEA	2	6	8	6	5	5	7	4	4	3	3	2	1	YES	YES	NO	NO	NIL
59	TEA	1	3	4	5	4	4	3	3	2	2	2	1	1	NO	YES	NO	NO	NIL

S.NO	Group	PS	VAS										PONV Score	Patient satisfac - tion	TechnicaL Failure	Rescue Analgesia	Brady - cardia	Hypo- Tension	Respiratory Depression
			15	30	2	4	8	16	24	30	36	48							
60	TEA	1	3	2	3	3	2	3	3	2	2	2	0	3	NO	NO	NO	YES	NIL
61	RSB	2	2	2	2	2	2	3	2	1	2	2	2	4	NO	NO	NO	NO	NIL
62	TEA	3	2	2	2	2	2	3	2	1	2	2	1	4	NO	NO	NO	NO	NIL
63	RSB	2	2	2	3	2	3	3	2	2	3	1	1	4	NO	NO	NO	NO	NIL
64	RSB	2	8	8	7	5	5	6	6	5	5	5	1	1	YES	YES	NO	NO	NIL
65	RSB	1	2	2	1	3	2	2	2	1	3	2	2	3	NO	NO	NO	NO	NIL
66	TEA	2	2	2	1	3	2	2	2	1	3	2	0	3	NO	NO	NO	YES	NIL
67	TEA	3	2	2	2	1	2	2	2	2	2	2	3	4	NO	NO	NO	NO	NIL
68	RSB	2	8	8	6	6	5	5	7	7	5	5	1	1	YES	YES	NO	NO	NIL
69	RSB	2	2	1	3	3	3	3	2	2	3	1	1	3	NO	NO	NO	NO	NIL
70	TEA	1	2	2	2	1	2	2	2	2	2	2	0	4	NO	NO	NO	NO	NIL
71	TEA	1	8	5	7	6	5	5	7	6	4	4	2	1	YES	YES	NO	NO	NIL
72	RSB	2	3	3	1	2	3	2	1	1	2	3	1	3	NO	NO	NO	NO	NIL
73	RSB	2	2	1	3	3	3	3	2	2	2	1	0	4	NO	NO	NO	NO	NIL
74	TEA	2	3	3	1	2	3	2	1	1	2	3	0	4	NO	NO	NO	NO	NIL
75	RSB	2	3	1	2	1	2	3	2	2	3	2	0	3	NO	NO	NO	NO	NIL
76	TEA	3	3	1	2	1	2	3	2	2	3	2	2	4	NO	NO	NO	NO	NIL
77	RSB	2	2	3	3	3	2	3	2	2	3	3	0	4	NO	NO	NO	NO	NIL
78	RSB	2	2	3	3	3	2	3	2	2	3	3	0	4	NO	NO	NO	NO	NIL
79	RSB	3	8	7	7	8	8	7	7	6	5	4	0	1	YES	YES	NO	NO	NIL
80	TEA	3	3	3	3	5	5	4	4	2	2	2	0	2	NO	YES	NO	NO	NIL
81	TEA	2	2	2	2	2	3	2	1	1	3	1	2	4	NO	NO	NO	NO	NIL
82	TEA	2	3	3	2	2	3	3	2	2	3	2	0	4	NO	NO	NO	NO	NIL
83	RSB	3	3	2	3	2	2	2	3	3	3	2	0	4	NO	NO	NO	NO	NIL
84	TEA	2	2	3	3	3	3	3	2	2	3	3	2	4	NO	NO	NO	NO	NIL
85	RSB	2	2	3	3	3	3	3	2	2	3	3	0	4	NO	NO	NO	NO	NIL
86	TEA	2	3	2	3	2	2	3	3	2	2	3	2	3	NO	NO	NO	NO	NIL
87	RSB	2	4	3	4	3	3	3	4	2	3	2	2	3	NO	YES	NO	NO	NIL
88	RSB	2	2	3	3	3	3	2	3	3	2	2	1	4	NO	NO	NO	NO	NIL
89	TEA	1	3	3	2	3	2	3	3	2	2	2	0	4	NO	NO	NO	YES	NIL
90	RSB	1	2	2	1	2	3	2	1	1	3	1	1	3	NO	NO	NO	NO	NIL

S.NO	Group	PS	VAS										PONV Score	Patient satisfac - tion	TechnicaL Failure	Rescue Analgesia	Brady - cardia	Hypo- Tension	Respiratory Depression
			15	30	2	4	8	16	24	30	36	48							
91	TEA	3	2	3	3	3	2	3	2	2	3	3	2	4	NO	NO	NO	YES	NIL
92	TEA	1	8	8	5	4	4	5	5	4	4	4	0	1	YES	YES	NO	NO	NIL
93	RSB	2	3	3	3	3	3	3	3	2	2	2	1	4	NO	NO	NO	NO	NIL
94	RSB	2	4	3	4	3	3	3	3	3	2	2	1	3	NO	YES	NO	NO	NIL
95	TEA	2	2	3	3	3	2	3	2	2	3	3	0	4	NO	NO	NO	NO	NIL
96	RSB	2	7	7	6	6	5	6	6	5	4	3	0	1	YES	YES	NO	NO	NIL
97	TEA	2	3	4	3	4	3	2	2	3	2	2	0	3	NO	YES	NO	NO	NIL
98	TEA	1	2	3	3	3	3	3	3	2	2	2	3	4	NO	NO	NO	YES	NIL
99	RSB	2	3	3	3	2	3	2	2	3	2	2	2	4	NO	NO	NO	NO	NIL
100	TEA	2	3	3	2	3	3	3	3	2	2	2	2	4	NO	NO	NO	NO	NIL

.NO	GROUP	PULSE RATE										SYSTOLIC BP									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
1	RSB	96	98	88	84	90	92	88	88	86	85	124	120	128	124	130	128	120	118	116	124
2	RSB	86	80	82	88	84	86	82	80	78	77	122	116	112	122	124	120	116	125	122	120
3	TEA	88	96	94	90	99	86	102	92	86	84	110	116	112	108	124	118	112	110	116	118
4	TEA	86	86	90	92	84	78	76	80	82	76	114	90	106	120	92	108	102	116	120	124
5	RSB	78	88	86	90	90	86	84	88	82	88	122	130	128	132	128	132	126	125	127	131
6	TEA	90	94	90	92	90	84	86	88	90	88	128	132	130	128	125	134	128	126	130	122
7	RSB	88	86	80	84	88	80	82	78	82	76	125	120	122	128	120	136	132	124	122	120
8	RSB	104	112	100	96	100	102	92	88	90	88	139	136	132	135	130	136	139	130	132	130
9	RSB	82	80	76	78	68	66	64	76	74	70	126	96	102	104	122	112	110	112	114	112
10	TEA	66	78	96	70	88	78	70	68	70	84	118	90	98	100	114	112	122	118	116	115
11	RSB	78	88	84	85	82	76	78	85	82	76	125	122	120	125	121	130	128	127	130	132
12	RSB	98	90	88	84	86	78	86	85	84	86	120	114	115	118	128	125	117	110	115	112
13	TEA	85	80	78	82	78	82	84	84	82	90	112	108	108	132	118	116	110	114	117	109
14	TEA	95	90	88	92	86	88	85	90	86	88	96	120	118	110	88	108	125	112	120	98
15	RSB	78	76	74	70	88	84	80	82	80	84	128	122	120	118	114	118	124	122	120	122
16	TEA	90	87	88	84	86	84	90	88	86	90	135	130	132	127	128	126	128	130	132	128
17	TEA	86	88	80	78	76	86	80	88	80	83	98	120	106	120	90	116	114	118	114	118
18	RSB	90	112	104	80	86	100	94	88	92	88	120	118	116	117	125	128	122	120	118	124
19	RSB	74	78	76	74	76	74	70	68	70	76	118	112	115	114	118	110	113	108	112	104
20	TEA	78	88	76	78	80	78	80	84	78	68	136	130	138	127	125	130	132	135	132	128
21	TEA	84	82	86	84	84	82	78	82	80	77	125	120	117	115	113	128	126	125	120	119
22	RSB	82	74	76	74	84	80	84	82	80	84	135	130	132	128	127	133	125	120	124	122
23	RSB	88	84	86	82	82	86	88	90	84	88	127	125	120	122	120	132	128	122	120	128
24	TEA	86	80	84	82	74	80	82	80	82	76	124	120	122	128	117	110	127	125	120	117
25	TEA	78	80	86	78	78	80	74	76	72	70	122	94	100	112	116	114	118	125	122	126
26	TEA	60	64	66	62	64	66	62	66	64	74	126	120	118	115	127	122	128	125	126	122
27	RSB	75	76	74	72	70	72	74	78	75	88	134	130	132	127	125	132	120	128	125	127
28	TEA	74	70	72	70	72	78	78	75	74	86	120	110	114	118	126	122	117	114	118	115
29	RSB	96	90	94	92	96	88	86	90	88	84	112	118	116	115	110	118	108	106	114	110

.NO	GROUP	PULSE RATE										SYSTOLIC BP									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
30	RSB	112	100	92	100	98	102	100	92	88	80	112	114	116	118	114	108	112	110	108	110
31	TEA	77	75	72	76	84	80	82	84	74	77	117	114	122	117	112	123	117	114	126	120
32	RSB	92	90	88	88	92	90	82	84	88	85	128	126	120	120	116	118	110	124	118	115
33	RSB	70	74	78	76	78	72	76	74	78	78	112	110	108	112	116	108	106	114	110	112
34	TEA	68	64	62	68	68	66	64	62	64	80	98	114	122	126	92	118	106	130	108	120
35	RSB	98	90	88	86	92	90	88	84	86	84	124	120	122	115	111	108	110	117	108	114
36	TEA	78	78	72	82	75	70	72	74	76	80	128	122	120	118	124	120	127	118	122	118
37	TEA	64	62	66	68	68	62	64	68	62	73	127	98	96	112	120	115	117	110	114	116
38	RSB	106	98	92	94	92	88	86	92	88	80	120	118	114	122	110	116	115	122	114	120
39	RSB	88	92	90	86	86	88	86	88	86	86	136	132	135	130	133	130	127	125	128	132
40	TEA	96	90	88	90	86	90	85	80	86	88	138	130	126	129	125	130	127	124	118	122
41	TEA	114	108	96	98	92	100	90	90	88	76	104	112	108	102	90	114	122	108	109	112
42	RSB	88	84	82	86	86	84	82	86	84	86	132	130	128	127	124	122	130	132	128	124
43	RSB	84	80	82	86	82	84	78	74	78	75	136	130	128	132	124	126	128	134	122	128
44	TEA	92	104	82	98	76	72	98	90	70	77	127	122	126	120	128	117	116	118	114	125
45	RSB	95	90	88	88	86	92	90	88	86	84	125	118	122	117	125	128	114	120	116	120
46	RSB	90	88	102	96	90	84	82	88	84	82	120	118	119	120	118	114	116	125	120	115
47	TEA	72	74	78	70	78	80	82	74	76	74	136	130	128	124	130	125	132	122	130	125
48	TEA	74	78	88	88	92	98	86	72	88	77	122	118	115	116	122	120	116	120	116	114
49	RSB	68	66	70	68	62	66	60	64	66	74	130	124	126	122	128	123	132	126	124	122
50	TEA	88	86	80	78	86	84	88	84	80	75	112	110	108	115	116	110	114	110	112	116
51	RSB	88	84	88	90	86	85	90	84	86	77	132	128	125	122	120	132	125	127	122	128
52	TEA	88	80	85	88	80	78	87	80	79	74	122	100	106	122	124	120	116	125	122	120
53	RSB	102	108	92	74	70	74	70	72	70	78	136	130	132	128	130	125	122	130	127	124
54	TEA	74	70	78	70	74	68	72	72	70	77	118	112	115	110	116	118	110	112	108	110
55	TEA	72	76	78	80	84	80	78	76	74	78	128	120	122	120	118	115	122	116	114	110
56	TEA	80	83	80	79	80	76	79	81	83	88	128	116	118	122	125	134	128	126	130	116
57	RSB	92	85	80	88	85	83	80	86	80	84	125	116	120	118	120	124	114	118	122	118
58	TEA	100	118	120	106	98	90	92	80	77	73	128	116	114	118	122	112	110	122	114	117
59	TEA	78	92	90	94	88	78	82	76	74	75	138	130	128	125	130	128	125	133	128	125

.NO	GROUP	PULSE RATE										SYSTOLIC BP									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
60	TEA	75	70	72	78	72	74	73	70	72	76	116	90	98	100	114	112	122	118	116	115
61	RSB	70	74	77	69	72	75	69	71	72	73	134	122	120	122	114	118	116	122	119	121
62	TEA	70	76	78	80	72	70	74	74	78	77	118	116	115	122	128	120	125	130	120	116
63	RSB	74	79	80	77	82	80	77	71	73	80	122	114	112	120	118	115	114	118	113	115
64	RSB	108	100	102	94	98	82	86	92	74	86	128	125	122	130	132	122	126	130	122	125
65	RSB	68	66	70	74	72	76	74	70	72	88	135	130	127	125	134	128	132	130	128	125
66	TEA	70	66	67	73	77	75	68	77	74	76	120	94	102	117	116	128	122	100	113	124
67	TEA	88	82	86	84	84	82	84	80	82	78	126	120	125	118	114	122	120	125	126	118
68	RSB	114	122	108	100	96	90	88	94	82	74	137	130	127	125	128	132	130	127	133	128
69	RSB	84	80	82	86	84	82	88	82	80	76	128	120	122	125	132	125	120	128	120	128
70	TEA	66	69	70	71	76	69	67	70	65	70	132	121	115	114	126	110	117	108	112	125
71	TEA	112	106	104	98	94	98	86	80	88	85	135	127	132	122	127	126	125	119	124	116
72	RSB	88	90	92	90	92	90	94	86	88	86	118	114	116	122	126	120	127	115	118	114
73	RSB	78	74	70	72	70	69	71	78	76	77	127	125	120	122	118	123	129	122	120	116
74	TEA	80	86	83	81	76	77	79	71	73	72	112	94	100	112	116	114	96	109	122	119
75	RSB	78	80	84	82	84	82	86	80	76	79	130	125	122	126	128	120	122	128	132	128
76	TEA	92	97	93	90	86	90	85	91	86	84	126	112	118	115	119	122	128	125	117	121
77	RSB	88	82	85	82	84	91	87	85	84	80	112	114	116	118	114	108	112	110	108	110
78	RSB	90	96	94	96	88	96	88	85	86	82	132	130	128	125	124	128	126	130	128	125
79	RSB	88	102	100	98	96	99	86	84	89	78	127	122	126	130	128	128	123	120	118	116
80	TEA	88	90	94	98	90	92	90	96	88	74	125	120	128	127	125	124	120	122	130	122
81	TEA	83	77	74	79	84	86	78	74	77	75	136	122	122	117	121	123	117	119	126	117
82	TEA	88	82	85	90	82	77	81	77	79	74	112	110	108	112	116	108	106	114	110	112
83	RSB	77	70	79	81	80	78	74	79	73	77	132	124	122	135	130	128	124	130	132	125
84	TEA	92	90	88	86	92	87	85	86	88	75	136	130	128	120	130	127	128	130	125	120
85	RSB	86	80	74	78	82	85	84	80	78	73	108	110	112	110	115	112	108	112	110	107
86	TEA	80	77	79	82	79	77	74	80	77	74	128	90	98	118	124	96	127	92	122	118
87	RSB	98	79	86	84	80	77	79	88	74	86	104	122	108	112	120	115	117	110	114	116
88	RSB	87	84	90	84	79	91	83	84	86	84	132	130	128	127	124	122	130	132	128	124
89	TEA	88	86	80	84	84	86	90	82	85	77	126	122	120	126	127	118	114	125	120	122

.NO	GROUP	PULSE RATE										SYSTOLIC BP									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
90	RSB	84	86	84	88	84	88	82	85	86	86	118	112	116	114	120	118	126	122	120	116
91	TEA	86	80	92	90	88	82	86	88	80	76	108	106	122	120	98	112	108	116	122	106
92	TEA	108	100	98	88	86	84	100	92	82	79	120	117	115	122	116	112	118	122	113	118
93	RSB	90	88	84	88	89	93	87	84	88	84	136	130	128	132	124	126	128	134	122	128
94	RSB	92	90	98	82	84	74	78	72	70	74	127	122	126	120	128	117	116	118	114	125
95	TEA	66	68	78	70	74	72	70	66	68	74	117	111	115	120	115	116	112	114	116	112
96	RSB	100	104	98	88	92	86	94	98	82	76	138	134	132	130	132	128	136	130	128	125
97	TEA	88	96	94	84	75	85	74	73	76	86	136	130	128	124	130	125	132	122	130	125
98	TEA	85	87	89	82	91	78	83	85	80	83	122	92	98	116	122	120	116	120	116	114
99	RSB	78	76	80	72	75	80	84	80	82	88	130	126	118	114	127	120	122	125	126	120
100	TEA	90	87	85	80	86	85	87	84	83	78	130	96	106	122	128	121	132	125	117	119

S.NO	GROUP	DIASTOLIC BP										MAP										SpO2									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
1	RSB	76	80	72	75	73	82	70	73	81	74	92	93	91	91	92	97	87	88	93	91	99	100	100	99	98	99	99	99	98	100
2	RSB	77	71	73	75	70	69	71	76	71	70	92	86	86	91	88	86	86	92	88	87	100	100	99	99	100	98	99	98	100	99
3	TEA	85	82	78	73	70	82	77	79	80	81	93	93	89	85	88	94	89	89	92	93	99	98	100	98	99	99	99	99	100	99
4	TEA	77	68	70	72	66	64	68	67	72	73	89	75	82	88	75	79	79	83	88	90	100	100	99	99	99	98	99	100	100	100
5	RSB	66	68	70	71	65	73	64	63	67	63	85	89	89	91	86	93	85	84	87	86	100	99	99	99	99	98	100	100	100	100
6	TEA	85	81	80	78	77	74	72	75	77	73	99	98	97	95	93	94	91	92	95	89	99	99	100	99	98	99	99	100	100	100
7	RSB	74	70	72	69	67	70	66	69	71	68	91	87	89	89	85	92	88	87	88	85	99	99	99	99	99	99	99	99	99	98
8	RSB	74	79	72	68	75	70	77	80	73	69	96	98	92	90	93	92	98	97	93	89	99	98	99	99	97	99	99	99	100	99
9	RSB	82	66	64	70	68	66	74	72	70	68	97	76	77	81	86	81	86	85	85	83	99	99	99	99	99	99	99	99	99	99
10	TEA	75	60	66	68	64	70	71	66	69	70	89	70	77	79	81	84	88	83	85	85	98	98	99	99	99	99	99	99	99	99
11	RSB	79	72	73	81	77	72	82	72	82	74	94	89	89	96	92	91	97	90	98	93	100	100	100	100	100	100	99	100	99	99
12	RSB	68	65	62	60	73	64	67	71	66	68	85	81	80	79	91	84	84	84	82	83	99	99	99	99	99	99	99	98	99	99
13	TEA	73	69	77	73	80	81	72	73	75	69	86	82	87	93	93	93	85	87	89	82	100	99	98	99	99	99	99	99	99	99
14	TEA	68	77	72	72	68	70	78	71	74	70	77	91	87	85	75	83	94	85	89	79	99	99	99	99	97	99	99	99	99	99
15	RSB	68	67	69	66	70	72	68	67	70	64	88	85	86	83	85	87	87	85	87	83	99	99	99	99	99	99	99	100	99	99
16	TEA	82	81	78	73	72	75	73	78	72	80	100	97	96	91	91	92	91	95	92	96	99	99	99	99	99	99	98	99	99	99
17	TEA	70	78	68	72	70	67	71	69	72	70	79	92	81	88	77	83	85	85	86	86	99	99	99	99	99	99	99	99	99	99
18	RSB	85	80	77	75	73	77	73	78	74	72	97	93	90	89	90	94	89	92	89	89	100	99	99	99	99	99	98	99	99	99
19	RSB	75	61	63	68	70	69	68	65	71	69	89	78	80	83	86	83	83	79	85	81	99	99	99	99	99	99	99	99	99	99
20	TEA	79	72	77	68	74	70	82	73	72	67	98	91	97	88	91	90	99	94	92	87	98	99	99	99	99	97	99	99	99	99
21	TEA	64	68	60	72	70	67	69	74	77	69	84	85	79	86	84	87	88	91	91	86	99	99	99	99	99	99	99	99	99	99
22	RSB	80	73	72	70	70	75	76	73	74	72	98	92	92	89	89	94	92	89	91	89	98	99	99	99	99	99	98	100	98	99
23	RSB	78	71	73	69	70	71	68	75	77	73	94	89	89	87	87	91	88	91	91	91	99	99	99	99	99	99	99	99	99	99
24	TEA	81	78	74	77	72	69	72	65	67	69	95	92	90	94	87	83	90	85	85	85	99	99	99	99	99	99	98	98	98	99
25	TEA	84	68	70	72	69	68	70	73	68	70	97	77	80	85	85	83	86	90	86	89	99	99	99	99	99	99	99	99	99	98
26	TEA	71	65	64	70	66	68	70	67	70	66	89	83	82	85	86	86	89	86	89	85	98	99	99	99	100	100	99	99	99	99
27	RSB	78	80	72	73	75	70	69	77	67	69	97	97	92	91	92	91	86	94	86	88	100	99	99	99	99	99	99	99	99	99
28	TEA	73	78	70	69	80	74	76	71	67	71	89	89	85	85	95	90	90	85	84	86	99	99	99	99	99	99	99	99	99	99

S.NO	GROUP	DIASTOLIC BP										MAP										SpO2									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
29	RSB	78	80	78	73	77	81	72	76	72	68	89	93	91	87	88	93	84	86	86	82	99	99	99	99	98	98	99	99	99	99
30	RSB	72	67	66	69	65	66	70	68	67	70	85	83	83	85	81	80	84	82	81	83	99	99	99	99	99	99	99	99	99	99
31	TEA	77	70	69	72	67	70	72	70	73	70	90	85	87	87	82	88	87	85	91	87	99	99	99	99	99	99	99	99	99	99
32	RSB	70	73	77	72	78	73	70	68	81	77	89	91	91	88	91	88	83	87	93	90	99	98	99	99	99	99	99	98	99	98
33	RSB	79	72	70	74	70	72	70	73	72	75	90	85	83	87	85	84	82	87	85	87	99	99	99	99	99	99	99	99	99	100
34	TEA	68	70	74	72	70	71	68	70	70	72	78	85	90	90	77	87	81	90	83	88	98	99	99	99	99	99	99	98	99	99
35	RSB	71	72	69	77	74	69	80	77	73	76	89	88	87	90	86	82	90	90	85	89	99	99	99	99	99	99	99	99	99	99
36	TEA	76	70	69	71	72	70	68	67	69	70	93	87	86	87	89	87	88	84	87	86	99	98	99	99	99	100	100	99	100	99
37	TEA	82	63	60	68	71	69	72	70	73	70	97	75	72	83	87	84	87	83	87	85	99	100	99	99	99	99	99	99	99	99
38	RSB	65	71	74	68	71	74	72	69	78	68	83	87	87	86	84	88	86	87	90	85	99	99	99	99	99	99	99	99	99	99
39	RSB	67	71	74	69	77	71	80	73	69	73	90	91	94	89	96	91	96	90	89	93	100	99	99	99	99	98	98	99	98	98
40	TEA	75	71	85	80	75	85	85	85	80	85	96	91	99	96	92	100	99	98	93	97	99	99	99	99	99	99	99	99	99	99
41	TEA	70	72	77	78	68	73	72	77	70	74	81	85	87	86	75	87	89	87	83	87	99	99	99	99	99	99	99	99	99	99
42	RSB	79	70	72	77	72	69	73	75	72	72	97	90	91	94	89	87	92	94	91	89	98	99	99	99	99	99	99	99	99	99
43	RSB	73	69	68	66	70	71	66	69	70	66	94	89	88	88	88	89	87	91	87	87	99	99	99	99	98	98	99	99	99	99
44	TEA	77	70	73	74	70	72	73	70	71	72	94	87	91	89	89	87	87	86	85	90	99	99	99	99	99	99	99	99	99	99
45	RSB	82	80	73	80	72	77	69	73	76	70	96	93	89	92	90	94	84	89	89	87	99	99	99	99	99	99	99	99	99	99
46	RSB	66	69	71	64	69	67	63	65	69	68	84	85	87	83	85	83	81	85	86	84	99	98	99	99	99	99	99	98	100	99
47	TEA	82	80	76	73	75	71	70	77	75	72	100	97	93	90	93	89	91	92	93	90	99	99	99	99	99	99	99	99	99	99
48	TEA	73	69	67	70	66	69	67	70	71	73	89	85	83	85	85	86	83	87	86	87	99	99	99	99	99	99	99	98	99	99
49	RSB	78	77	72	70	73	74	72	70	74	73	95	93	90	87	91	90	92	89	91	89	100	99	99	99	99	99	99	99	98	99
50	TEA	62	65	69	62	71	69	63	70	68	71	79	80	82	80	86	83	80	83	83	86	99	98	99	99	99	100	100	99	99	99
51	RSB	70	80	72	80	68	66	72	68	66	72	91	96	90	94	85	88	90	88	85	91	99	100	99	99	99	99	99	99	99	99
52	TEA	75	60	62	70	67	65	69	70	65	68	91	73	77	87	86	83	85	88	84	85	98	99	99	99	99	99	99	99	98	99
53	RSB	85	90	85	78	80	88	82	80	88	85	102	103	101	95	97	100	95	97	101	98	99	99	99	99	99	98	98	99	99	99
54	TEA	66	62	60	68	64	65	72	70	65	73	83	79	78	82	81	83	85	84	79	85	99	99	99	98	99	99	99	99	99	99
55	TEA	68	64	72	63	70	72	68	62	68	70	88	83	89	82	86	86	86	80	83	83	99	99	99	99	99	99	99	99	99	99
56	TEA	82	77	74	79	80	73	76	72	77	72	97	90	89	93	95	93	93	90	95	87	99	99	99	99	99	99	99	99	99	99
57	RSB	78	80	82	77	75	74	76	79	72	74	94	92	95	91	90	91	89	92	89	89	99	100	100	100	100	100	99	100	99	99

S.NO	GROUP	DIASTOLIC BP										MAP										SpO2									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
58	TEA	73	70	68	70	67	72	69	66	70	69	91	85	83	86	85	85	83	85	85	85	98	99	99	99	99	99	99	98	99	99
59	TEA	75	80	85	70	68	72	66	70	68	72	96	97	99	88	89	91	86	91	88	90	99	99	98	99	99	99	99	99	99	99
60	TEA	81	62	64	70	69	72	70	72	73	74	93	71	75	80	84	85	87	87	87	88	97	99	99	99	97	99	99	99	99	99
61	RSB	83	74	77	73	76	73	78	74	72	77	100	90	91	89	89	88	91	90	88	92	99	99	99	99	99	99	99	100	99	99
62	TEA	85	90	85	85	80	88	80	80	80	85	96	99	95	97	96	99	95	97	93	95	99	99	99	99	99	99	98	99	99	99
63	RSB	77	80	85	80	75	85	85	85	80	85	92	91	94	93	89	95	95	96	91	95	99	99	99	99	99	99	99	99	99	99
64	RSB	68	66	70	72	75	68	70	73	70	72	88	86	87	91	94	86	89	92	87	90	99	99	99	99	99	99	98	99	99	99
65	RSB	85	90	85	92	80	88	84	80	82	85	102	103	99	103	98	101	100	97	97	98	99	99	99	99	99	99	99	99	99	99
66	TEA	82	66	69	71	73	77	80	75	73	76	95	75	80	86	87	94	94	83	86	92	99	99	99	99	99	97	99	99	99	99
67	TEA	70	80	88	80	75	85	82	78	80	77	89	93	100	93	88	97	95	94	95	91	99	99	99	99	99	99	99	99	99	99
68	RSB	86	90	85	85	95	88	80	80	80	85	103	103	99	98	106	103	97	96	98	99	99	99	99	99	99	99	98	100	98	99
69	RSB	64	68	62	70	72	70	72	66	64	70	85	85	82	88	92	88	88	87	83	89	99	99	99	99	99	99	99	99	99	99
70	TEA	75	72	69	67	65	69	70	68	72	71	94	88	84	83	85	83	86	81	85	89	99	99	99	99	99	99	98	98	98	99
71	TEA	73	67	69	66	70	68	64	67	69	67	94	87	90	85	89	87	84	84	87	83	99	99	99	99	99	99	99	99	99	99
72	RSB	75	80	85	88	75	83	79	77	83	85	89	91	95	99	92	95	95	90	95	95	100	99	99	99	100	100	99	99	99	99
73	RSB	81	74	76	70	72	77	72	74	70	71	96	91	91	87	87	92	91	90	87	86	99	99	99	99	99	99	99	99	99	99
74	TEA	77	60	63	69	75	68	70	69	71	69	89	71	75	83	89	83	79	82	88	86	99	99	99	99	99	99	99	99	99	99
75	RSB	86	87	85	84	87	88	80	82	82	86	101	100	97	98	101	99	94	97	99	100	98	99	99	99	98	98	99	99	99	99
76	TEA	72	67	65	68	63	66	69	67	68	69	90	82	83	84	82	85	89	86	84	86	99	99	99	99	99	99	99	99	99	99
77	RSB	74	70	69	67	69	65	68	70	67	66	87	85	85	84	84	79	83	83	81	81	99	99	99	99	99	99	99	99	99	99
78	RSB	72	72	77	73	75	72	68	67	75	70	92	91	94	90	91	91	87	88	93	88	99	98	99	99	99	99	99	98	99	99
79	RSB	85	78	85	77	80	82	80	72	74	79	99	93	99	95	96	97	94	88	89	91	100	100	100	99	100	100	99	100	99	99
80	TEA	83	80	77	70	71	75	79	82	78	85	97	93	94	89	89	91	93	95	95	97	98	99	99	99	99	99	99	98	99	99
81	TEA	79	74	73	75	77	72	75	70	73	71	98	90	89	89	92	89	89	86	91	86	99	99	98	99	99	99	99	99	99	99
82	TEA	71	68	69	72	75	70	73	69	67	68	85	82	82	85	89	83	84	84	81	83	99	99	99	99	97	99	99	99	99	99
83	RSB	84	80	78	75	77	73	76	74	77	73	100	95	93	95	95	91	92	93	95	90	99	99	99	99	99	99	99	100	99	99
84	TEA	82	77	80	82	80	78	67	71	77	81	100	95	96	95	97	94	87	91	93	94	99	99	99	99	99	99	98	99	99	99
85	RSB	68	60	66	62	64	69	72	68	70	66	81	77	81	78	81	83	84	83	83	80	99	99	99	99	99	99	99	99	99	99
86	TEA	85	65	69	71	73	76	64	78	80	73	99	73	79	87	90	83	85	83	94	88	99	99	99	99	99	99	98	99	99	99

S.NO	GROUP	DIASTOLIC BP										MAP										SpO2									
		15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48	15	30	2	4	8	16	24	30	36	48
87	RSB	75	69	72	69	70	72	70	73	69	72	85	87	84	83	87	86	86	85	84	87	99	99	99	99	99	99	99	99	99	99
88	RSB	70	67	66	69	65	71	74	70	67	69	91	88	87	88	85	88	93	91	87	87	99	99	99	99	99	97	99	99	99	99
89	TEA	75	72	72	78	68	70	71	66	68	72	92	89	88	94	88	86	85	86	85	89	99	99	99	99	99	99	99	99	99	99
90	RSB	78	90	82	78	80	75	72	74	76	66	91	97	93	90	93	89	90	90	91	83	99	99	99	99	99	99	98	100	98	99
91	TEA	75	82	85	77	79	82	76	73	80	77	86	90	97	91	85	92	87	87	94	87	99	99	99	99	99	99	99	99	99	99
92	TEA	82	84	85	77	73	72	76	80	78	85	95	95	95	92	87	85	90	94	90	96	99	99	99	99	99	99	98	98	98	99
93	RSB	77	72	69	73	75	73	68	68	70	72	97	91	89	93	91	91	88	90	87	91	99	99	99	99	99	99	99	99	99	99
94	RSB	81	74	74	71	77	73	76	73	70	73	96	90	91	87	94	88	89	88	85	90	99	99	99	99	100	100	99	99	99	99
95	TEA	71	80	74	77	81	74	82	78	80	72	86	90	88	91	92	88	92	90	92	85	99	99	99	99	99	99	99	99	99	99
96	RSB	68	60	62	67	59	66	62	66	60	62	91	85	85	88	83	87	87	87	83	83	99	99	99	99	99	99	99	99	99	99
97	TEA	73	70	69	67	68	70	66	67	66	69	94	90	89	86	89	88	88	85	87	88	99	99	99	99	98	98	99	99	99	99
98	TEA	81	63	66	72	76	70	73	69	73	74	95	73	77	87	91	87	87	86	87	87	99	99	99	99	99	99	99	99	99	99
99	RSB	62	58	62	62	66	65	68	71	66	67	85	81	81	79	86	83	86	89	86	85	99	99	99	99	99	99	99	99	99	99
100	TEA	79	62	64	69	70	72	68	69	72	75	96	73	78	87	89	88	89	88	87	90	99	98	99	99	99	99	99	98	99	99